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CONFIRMATION AND NON-CONFIRMATION OF  
SOLUTIONS IN A PROBLEM SOLVING SITUATION

Thesis for the Degree of M. A.  
MICHIGAN STATE UNIVERSITY

Ronald Arthur Hoppe

1960



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IN A PROBLEM SOLVING SITUATION

By

Ronald Arthur Hoppe

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

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## ACKNOWLEDGMENTS

I am very grateful to Dr. Milton Rokeach for his suggestions and guidance throughout this research. Also, I appreciate Dr. Paul Bakan and Dr. Frank Restle's continuous, helpful criticism.

I am especially thankful for the encouragement of my wife, Jo Ann, whose constant help was invaluable.

R.A.H.

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Approved Milton Rokeach

## ABSTRACT

This study was designed to examine the effects of confirmation of solutions to a complex problem. Two kinds of theories suggested that if a person does not receive confirmation or knowledge of results of his solution to a problem, he will not perform well on a succeeding, similar problem. Previous research has used two problems suitable for this study. These were the Joe Doodlebug problems. The problems were difficult, complex problems although at first glance they appeared simple. They involved the overcoming of certain typical beliefs about insects and the integration of new beliefs before a solution could be reached. An earlier study had demonstrated transfer to a second problem when the subjects' solutions to the first problem were confirmed.

The hypothesis was that subjects whose correct solutions to the first Doodlebug problem were confirmed would solve the second Doodlebug problem in a shorter time than those subjects whose solutions to the first problem were not confirmed.

A tape recorder served as an experimenter because a human experimenter might unconsciously, impart some confirmation to the subjects in the non-confirmation group. Also, because of the complexity of the problems, it was decided to have a fake subject appear to be working with the true subject on the problems.

Sixty-one male, introductory psychology students were divided into two groups. The subjects in one group were given the first problem and their solutions were not confirmed by a tape recorder.

Then, they were given the second problem. The other group of subjects were treated similarly except their solutions to the first problem were confirmed. The subjects' solution times and verbal conversations in both groups were recorded. Because the two groups differed in the time it took them to solve the first problem, their solution times of the second problem could not be compared directly. A ratio score of the solution time of the second problem divided by the solution time of the first problem was computed for each subject. The two groups were compared using this score and were found not to differ significantly. The groups were also compared with respect to the time spent analyzing and synthesizing the problems. Again, no significant differences were found. The recordings of the subjects' conversations were content analyzed. A comparison of the groups with respect to this verbal data also yielded no significant differences. The lack of effect due to the confirmation was reliably demonstrated.

In other research in which the solutions to the Doodlebug problem were confirmed by human experimenters transfer was demonstrated. The present study did not demonstrate the same degree of transfer using a tape recorder as an experimenter. It was suggested that perhaps a human authority is necessary for confirmation to have an effect.

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## INTRODUCTION

The problem which this study attempts to examine is one which has derived from the work of Rokeach (1960). In Rokeach's research a special problem was employed in order to test various hypotheses which followed from his theory. This problem was originated by M. Ray Denny in 1945 and has been adapted to its present form by Rokeach and Denny. The problem has as its main character a fictional insect named Joe Doodlebug who lives in a strange world where his behavior is controlled by rules which are in opposition to those of our everyday life. A person must do away with his beliefs, establish a new set of beliefs and integrate these beliefs in order to solve the problem. The beliefs which a person must overcome to solve the problem have been described by Rokeach as follows:

- (a) The facing belief. In everyday life we have to face the food we are about to eat. But Joe does not have to face the food in order to eat it. He can land on top of it.
- (b) The direction belief. In everyday life we can change direction at will. But Joe is not able to do so because he is forever trapped facing north. Thus, the only way Joe can change direction is by jumping sideways and backwards.
- (c) The movement belief. When we wish to change direction in everyday life there is nothing to stop us from doing so immediately. But Joe's freedom of movement is restricted by the fact that once he moves in a particular direction--north, south, east or west--he has to continue four times in this direction before he can change it. Thus, when Joe stops to survey the situation at the moment his master places the food down three feet west of him, he may or may not necessarily be a free bug. He could have stopped in the middle of a sequence of jumps rather than at the end of a sequence.

While solving the problem the subject enters a domain which is not familiar to him. He is trying to progress to a solution which is somehow not dependent upon rules which he has previously learned. This is a highly ambiguous and at times frustrating situation. Because old rules won't work, the subject must find new rules, but how is he to know these rules are correct? In previous experiments with the Doodlebug problem the subjects have asked for confirmation of the new ideas which they develop. In other words, the experimenter has been the authority in the situation to which the subject must appeal to check out his notions. Because the Doodlebug problem is ambiguous and because old rules won't work, the experimenter becomes the authority in this new world. As Rokeach puts it: "At every turn, the fate of his (subject's) mental explorations is dependent upon what the experimenter chooses to confirm or disconfirm." When the subject reaches the solution and asks the experimenter if he is correct and the experimenter replies that he is, we may expect activity toward the solution to stop. What if the experimenter did not say whether the subject was correct or not? What effect would this have on the subject? This is the question which this study examines.

To explore the effect of confirmation of solution versus non-confirmation of solution we decided to examine the behavior of the subject in a two problem setting. If non-confirmation of the solution of the Doodlebug problem confuses or disrupts the subject in any way, this should evidence itself by delaying the solution of a succeeding problem which is similar to the original problem. This second problem was available due to the work of Oram (1957) who designed a problem similar to the Doodlebug problem in order to study "party-line" thinking. The original problem has become known as

the no-canopy problem and the Oram problem is known as the canopy problem. Oram added a canopy to the situation which required the subject to arrive at a different solution (a complete description of both the canopy and no-canopy problems appears in the procedure section). Oram found evidence of positive transfer from the no-canopy problem to the canopy problem when the solution to the no-canopy problem was confirmed. The basic design of our experiment was to present the no-canopy problem to a group of subjects, allow them to solve it, not confirm their solutions, and follow this with the canopy problem. The solution time of the second problem was measured and compared to a control group which was treated identically except that their solution to the canopy problem was confirmed. Because of the nature of the Doodlebug problem--"a miniature cosmology"--we expected that when the subject's authority did not confirm the subject's solution he would feel lost in this strange world and be unaware of the proper rules. Therefore, the subject would not solve a second problem as fast as subjects who had been confirmed.

How do the preceding notions fit into general learning theory? Some famous learning theories have at their foundation the postulate that an organism learns a performance by having the performance followed by some reward (Thorndike, 1911; Hull, 1943). Reward might be considered to be the same as confirmation. The rat learns to turn right in a T-maze because he has received rewards for right turns. Being anthropomorphic, the rat is "told" he is correct by the experimenter giving the rat some, say, bran mash when he turns right in the T-maze. The experimenter is the authority for the rat. After being "told" he is correct for a few trials, the rat learns to turn right fairly consistently, and, furthermore, when placed in a different but

similar T-maze, the rat would most likely turn right, showing positive transfer. Comparing our notion of confirmation with this simple learning study we find that bran mash acts as confirmation. The suggestion from learning theory is that if confirmation is lacking, there is no learning, and also, no transfer.

One might criticize this comparison between the rat and the human being because there is a world of difference between a college sophomore who has had a variety of experiences with problems of all kinds and a white rat who has never seen a T-maze in his life. This, undeniably, is true. We can't expect to find a college sophomore who is as naive as a white rat. The learning theorists have handled this problem by constructing tasks which they feel human subjects have not experienced, such as the pursuit rotor, a list of nonsense syllables, etc. While we can assume that humans lack experience with these learning tasks, we cannot assume the same with respect to problem solving. This assumption, however, is necessary if confirmation is to have an effect. Consider the following mundane example: If we were to give a college sophomore a series of addition problems and not tell him whether or not he was correct after each problem, we would not expect him to do any worse than a sophomore who was told he was correct after each problem. This is because the subject can obtain his own confirmation or, if you like, reward. Giving an adult the problem: "Find the sum of the numbers 16 and 9." He would probably soon find the solution to be 25. This solution would have an "automatic" confirmation based on past learning. The subject has learned the rules of mathematics from authorities in the past and can observe for himself whether he is correct or not. No longer does he need an authority to tell him he is correct. If he has

any doubt, he can subtract 9 from his solution and if this equals 16, he would receive further confirmation of his solution. This confirmation also derives from past learning.

The Doodlebug problem, although it certainly involves some past learning, appears to be a new and different problem for adults. It involves adopting new beliefs and requires an integration of these beliefs for a solution to be reached. Because of this, an authority who confirms correct answers is needed so that one can learn the rules of the game. Considering only this aspect of newness or strangeness we might say that the Doodlebug problem is similar to the learning tasks used in human learning studies. With these tasks the subject has not experienced the situation before, and, similarly, with the Doodlebug problem the subject has not experienced the situation before. Therefore, we could expect the effect of confirmation to be similar.

With respect to motor learning and confirmation there is a great deal of experimental evidence available. When we're concerned with this topic, confirmation comes under the heading of "knowledge of results." In various training procedures knowledge of results has been manipulated with sundry results. Generally, however, the effect of withholding knowledge of results is to decrease learning. For efficient motor learning one must receive information about how well he is performing (Ammons, R. B. 1956). Absence of confirmation delays learning.

There are a few dangers involved comparing motor learning with solving the Doodlebug problem. First, the study of the effect of withholding knowledge of results is concerned with repeated trials of the same tasks. The subject works on trial 1, receives or does not receive confirmation, works on trial 2, receives or does not receive

confirmation etc. With this sort of task each trial is the same and the rate of learning is examined--a perfectly reasonable venture--but one which is not quite like two Doodlebug problems. To consider a motor task and the Doodlebug problems comparable we would have to say the canopy Doodlebug problem is just another trial of the no-canopy problem, which is ridiculous. One type of Doodlebug problem followed by another involves two similar situations rather than two trials of the same task.

A second difference between the Doodlebug problems and motor learning is that there has been a general recognition of a distinction between problem solving and learning. Problem solving has been said to involve the "discovery" of a proper response which requires an organization and integration of past experience, whereas learning concerns reproduction (Duncan, 1959). A sharp distinction is no longer a crucial issue, but this does not say that they do not involve different processes, or at least a complicated interaction of the learning principles. This appears to be true since we find that several experimenters are working industriously to relate problem solving to learning with sporadic success (also reported in Duncan, 1959).

While confirmation in the form of knowledge of results has been extensively studied in motor learning, to my knowledge it has not been examined in problem solving.<sup>1</sup> The two most recent review articles of problem solving (Duncan, 1959; Gagné, 1959) have nothing to say about the effect of confirmation. One suspects that in some cases confirmation is assumed to have no effect. This would be true

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<sup>1</sup>In a verbal communication D. M. Johnson stated that he also does not know of any study concerning this area.

of the problems which are similar to the math problems mentioned earlier where the "self-confirmation" is available. With other problems involving new experiences we could expect that confirmation might have some effect.

To restate the notions involved in this research we are saying that an authority who confirms is necessary in a new situation such as the Doodlebug problems. For a person to learn the rules in this new situation the authority must tell him that his thinking has been correct. If the authority neither approved or disapproved of a solution, the solver would not know whether or not his organization and integration was correct, and would not tend to organize a succeeding, similar problem in a like fashion. Repeating the hypothesis: Subjects whose correct solutions to the no-canopy Doodlebug problem (first problem) are confirmed will solve the canopy Doodlebug problem (second problem) in a shorter time than those subjects whose solutions to the no-canopy problem are not confirmed. A test of this hypothesis should give information about the effect of confirmation on problem solving.

Before describing the procedure of this study, certain methodological adjustments must be mentioned. Although the hypothesis seemed simple enough to test--by giving the two Doodlebug problems to two groups of subjects, confirming one and not the other--this was not the case.

The nature of the Doodlebug problem is such that a person attempting to solve it will come up with several wrong solutions. Almost everyone who attempts to solve the problem arrives at incorrect answers before finally finding the correct solution. In the group which does not receive confirmation how are these incorrect



solutions to be handled? If the authority (experimenter) hands out the problem, gives the instructions, etc., what does he do when a subject comes up with a false solution? Hardly any subjects would solve the problem correctly if the authority said nothing, and, therefore, we would have no common basis for comparing these solution times with those of the control group who receive confirmation. If the authority, instead of not doing anything with the incorrect solutions of persons in the experimental group, rejects these solutions, the subjects will have received confirmation by elimination, that is, when the authority no longer rejects a solution, the subject will know it's correct. Even supposing that this difficulty could be overcome by the authority, we would still run the risk of some kind of unconscious confirmation being imparted by the authority. Perhaps an approving facial gesture, or a certain tone of voice would convey the idea that the solution is correct. This would confirm the subject's solution.

To avoid the above mentioned inconveniences a unique methodological adjustment was made. A tape recorder became the authority. The tape recorder was fitted with tapes which gave the subject the proper instructions, and depending upon which group the subject was in, it gave the subject the correct answer, or else it gave the subject no answer. By having the recorder tell the subject what the correct answer was, the subject could compare this with his answer to see if he was correct. This, acted as confirmation of the subjects' correct answer. If the subject was in the experimental group, the tape recorder issued no answer and the subject could not perceive any unconscious approving or disapproving of his answer. Also, the subject could not ask the tape recorder any questions which could lead

to a confirmation. In a pilot study prior to introducing the tape recorder we found the subject's questions particularly searching, and it was difficult for the experimenter not to in some fashion approve of the correct answer.

While the tape recorder solved the problem of unconscious confirmation we were still faced with the problem of having the subjects in the experimental group arrive at a correct solution. The tape recorder could not respond to each solution in terms of its correctness or incorrectness because this would also be confirming by elimination. Some way had to be found to reject the incorrect solutions without giving the subject confirmation from an authority. This was done by having a non-authority reject the incorrect solutions. The non-authority appeared as another student subject who was also working on the problem. We shall call this non-authority the confederate. The confederate was actually a graduate student involved in the research. To the real subject the experiment appeared to be one in group problem solving involving himself and another student. This group of two was supposed to arrive at a correct solution to the problem. The confederate generally acted quite dull; he didn't offer any positive suggestions to the solution but showed how certain attempted solutions were incorrect. The way in which the confederate rejected wrong solutions was to read the part of the instructions (which both the subject and confederate had before them) which negated the subject's solution. For example, when the subject came up with a wrong solution the confederate might say: "Gee, I don't know . . . (pause) . . . Oh, it says here: 'Joe cannot turn around.'" The confederate was not to aid or hinder the subject in any way except reject incorrect solutions. At times the confederate might talk of a

particular part of the instructions to give the appearance of being concerned and working on the problem. When the subject arrived at the correct solution and asked the confederate what he thought, the confederate would reply that he didn't know and he would remain vague and non-committal until the subject took it upon himself to turn in the solution. Interviewing the subjects at the conclusion of the experiment we found that most subjects thought the confederate was a rather slow witted fellow who didn't offer any help, and they felt that it was left to them to solve the problem.

A third person was present during the problem solving. This person we labelled as the machine operator for he appeared to the subjects to be a person who was simply there to operate the two tape recorders (one which was used to record the conversation and the other to give the instructions etc.). This machine operator was the true experimenter; he surreptitiously timed the subject's on both problems, however, he told the subjects that he wasn't familiar with the research but was there simply to operate the machines. This left the instruction giving tape recorder as the only authority present.

## PROCEDURE

### Subjects

The subjects were 61 male introductory psychology students. Males only were used to avoid any unknown interaction between male confederates and female subjects. The subjects were tested in a small sound proof room during the winter, spring, summer and fall terms of 1958. The subjects were placed in one of the following groups according to an unsystematic order:

### Groups

- Group A. This group was told at the start of problem one that they would be told the correct answer to the problem when they finished. At the conclusion of problem one they were told the correct answer and were given problem two. At the conclusion of problem two they were not told the correct answer.
- Group B. This group was the same as A except at the conclusion of problem one they were not told the correct answer.
- Group C. This group was told at the start of problem one that they would not be told the correct answer when they had finished. At the conclusion of problem one and also at the conclusion of problem two they were not told the correct answer.
- Group D. This group was the same as C except that at the conclusion of problem one they were told the correct answer.

For purposes of this research, groups A and D will be combined and labelled the confirmation group. Groups B and C will be combined and labelled the non-confirmation group. For a discussion of the effect of telling subjects to expect or not to expect the correct answer see Marr (1960). Thirty of the subjects had John Marr as the machine operator and Ronald Hoppe as the confederate. These roles were reversed with the other thirty-one of the subjects. The last subject tested in Group B was excluded from the analysis in order to make computations easier. Evidence obtained from interviewing the subjects after the experimental session indicated that only two of the subjects had suspected that something unnatural was occurring. These two didn't say that they had suspected the confederate or machine operator was connected with the research but, instead, said that they had a suspicion that, as one subject put it, "something fishy was going on."

Each subject volunteered to participate in the experiment by signing his name next to a specific date and time listed on a sheet posted in the hall near the introductory classrooms. The experiment was entitled: "Group Dynamics Experiment" so that the subject would anticipate at least one other student to be participating in the experiment with him. To further this feeling, there was a space for two people to sign at each listed time, and in one of these spaces appeared a false name. This name was an alias which was used by the confederate.

When the subject arrived at the appointed time, he was generally met by the machine operator because the confederate would wait in a place where he could observe without being noticed. After the subject arrived the confederate would come to the experimental room.

This was so that any similarity, such as age, between the machine operator and confederate would not be as noticeable. The machine operator would introduce himself to the subject as someone who was there to operate the tape recorders and that there was another subject expected. The confederate would arrive asking if it was the place for the "Group Dynamics Experiment." The machine operator would say that it was, ask him in and then the experimental session would start by the machine operator turning on the tape recorder which gave the following instructions:

"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."

The machine operator would then pass to both the subject and the confederate the following 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.

#### 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 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 Joe Doodlebug had to take four jumps, no more and no less, to reach the food?

When the subject finished reading the problem the tape recorder was turned back on: "Now, let us read the problem over together," The tape recorder would present the above problem. At the end of this the recorder would say: "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 above "not" was included for groups C and D.

Following this the confederate asked the subject, appropriately either: "Did he say we would be told the correct answer?" or,

"Did he say we would not be told the correct answer?" This was done in order to aid the reception of the anticipating and non-anticipating conditions.

At the end of the first five minutes the tape recorder announced: "Machine operator pass out the hint . . . (a pause while the machine operator passed out hint 1 which was typed on a 3 x 5 card) . . .

"Joe does not have to face the food in order to eat it."

Five minutes later the machine operator was instructed to pass out the next hint and the tape recorder announced the hint: "Joe can jump sideways, as well as backwards and forwards."

And five minutes later the tape recorder instructed the machine operator to pass out the hint which was announced by the recorder:

"When the master placed the food down, Joe had just taken one jump east."

At the conclusion of this hint the machine operator shut off the instructing tape recorder. When the subject had arrived at a solution and turned it in, the machine operator turned on the recorder which would announce for groups A and D (confirmation groups): "The correct answer is that since Joe had taken one jump east, he must take three more jumps east and one jump west, landing on top of the food. If you had that answer you were right." For groups B and C (non-confirmation groups) the recorder announced: "I will not tell you what the correct answer is so you will not know whether you are right or wrong."

Following this, the instructions for the second problem began: "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." The machine operator collected the first problem and then passed out the second problem which was as follows:

#### 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?

This problem differs from the first problem in the description of the situation. Here it will be noticed that there is a low canopy over the food. This requires a different solution to the problem.

When the subject had finished reading, the tape recorder repeated the problem. After this, the tape recorder said: "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."

The hints were given at five minute intervals to the subject and confederate on 3 x 5 cards and spoken by the tape recorder: Hint 1, "Joe must face the food in order to eat it." Hint 2, "Joe had just taken one jump west when his master placed the food down." Oram's original problem contained three hints, but one of these hints was the same as the first problem and this was included in the conditions of the second problem. This was the "sideways" hint (see condition 6). This change was made in order to reduce the total experimental time.

After the second hint the tape recorder was shut off and the machine operator waited for the subject to turn his solution in. When this occurred, the recorder was turned on, saying: "Now that you have finished you may call me at my home tonight if you like. My name is McKeever, and my phone number is Edgewood 7-0624." The subject would write down the name and number on the scrap paper which had been made available to him. The machine operator would say that the experiment was finished and that there was a phone in the hallway next to the experimental room if they wanted to use it. When he called the above number and asked for Mr. McKeever he was told that McKeever was not home but would return in 15 minutes.<sup>1</sup>

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<sup>1</sup>The author's wife, Jo Ann Hoppe, answered the phone and gave out the above mentioned information.

If he called again, he was told that McKeever would be home in 5 minutes. If he called again, he was told that McKeever would be home shortly. If he reached for the phone for a fourth time, the confederate would stop the experiment at this time and explain to the subject what the experiment was about and have him return to the experimental room. Only one subject attempted to phone four times. When the subject finally decided to leave, the confederate who had been with him all the time would say that the machine operator wanted them to come back to the experimental room. On the subject's return, he was told that the persons whom he had been working with were experimenters. The subject was then asked the following questions designed to find out if he had been suspicious of the procedure or felt he had received help or confirmation from the confederate:

1. Did you suspect that the person working with you was an experimenter?
2. Do you feel he helped you solve the first problem?
3. Do you feel he confirmed your solution to the first problem?
4. Do you feel he helped you solve the second problem?
5. Do you feel he confirmed your solution to the second problem?

The few subjects who answered yes to questions 2 and 4 were asked: "In what way?" Most of these subjects said that they were helped by having the confederate point out to them their wrong solutions.

The subjects were then told the purpose of the research and dismissed.

## RESULTS

Table 1 presents the mean times taken by both groups to solve both problems. The hypothesis was that the confirmation group would solve problem 2 faster than the non-confirmation group. Because of the discontinuity of the data (i. e. subjects were given 45 minutes in which to solve each problem, and if they did not solve it in the allotted time, they were stopped) and, also, because the solutions times did not distribute themselves normally, a White's rank test (Edwards, 1956) was employed to test the differences between the groups. This showed that the two groups differed significantly in the time taken to solve the second problem,  $z = 2.32$ ,  $p = .02$ . However, they also differed, not quite significantly, in the time taken to solve the first problem,  $z = 1.93$ ,  $p = .07$ . Since both groups were treated identically during the first problem, the reason for their difference must have been due to a sampling difference. For some reason, faster solvers were in the confirmation group, so the difference between the two groups in the second problem does not indicate a difference due to confirmation.

To handle these difficulties a new score was devised to test the differences in change between the two groups. A solution savings ratio was computed for each subject. This was the ratio of the solution time of problem two to the solution time of problem one:

$$\text{Solution savings ratio} = \frac{\text{Solution time of problem 2}}{\text{Solution time of problem 1}}$$

The savings ratio indicates the proportion of solving time of the first problem spent on the second problem. A person who solved the

TABLE 1  
MEAN SOLUTION TIMES\*

|                                                                                                    | Confirmation<br>Group | Non-confirmation<br>Group |
|----------------------------------------------------------------------------------------------------|-----------------------|---------------------------|
| Problem 1                                                                                          | 18.82                 | 22.82                     |
| Problem 2                                                                                          | 18.92                 | 25.46                     |
| Savings ratio<br>( $\frac{\text{Solution time of problem 2}}{\text{Solution time of problem 1}}$ ) | 1.091                 | 1.251                     |

\* These means are presented for comparison purposes only and did not enter into the statistical analysis of the data.

second problem in the same amount of time as the first would have a savings ratio equal to 1. Persons who solved the second problem faster than the first would have a low savings ratio, and persons who took longer on the second problem than they did the first would have a ratio greater than 1. The mean savings ratio for each group is also shown in Table 1. A White's rank test of the difference between the groups yielded a non-significant result,  $z = .96$ ,  $p = .34$ . In fact, a glance at the means of the savings ratios indicates that, generally, the second problem took longer to solve because the means are greater than 1.

By using a ratio we no longer had a discontinuous variable. But the distribution of the savings ratio was still not normal even though it was closer to a normal distribution than were the solution times. Because of the above fact and also because of what Norton (reported in Lindquist, 1953) has shown with respect to the F-ratio and non-normality, we decided to test the hypothesis further using an analysis of variance design. By using the analysis of variance we were able to account for more variance in the scores than could be accounted for by the use of other methods of testing differences. Lindquist describes the multi-factor design which was used. The results of the analysis of variance is shown in Table 2. (The anticipation factor does not concern us other than another source of variance but is discussed by Marr, 1960.) The analysis of variance test of the hypothesis further supports the findings with the White's rank test. No matter how it is tested, there is no significant difference in transfer between the confirmation and non-confirmation groups.

The above results are the ones which concern the a priori hypothesis, and, of course, do not support it. The implications of

TABLE 2

ANALYSIS OF VARIANCE OF SAVINGS RATIO

( $\frac{\text{Solution Time of Problem 2}}{\text{Solution Time of Problem 1}}$ )

| Source           | df | MS    | F     |
|------------------|----|-------|-------|
| A (confirmation) | 1  | .384  | < 1   |
| B.(confederate)  | 1  | 1.003 | 1.38  |
| C (anticipation) | 1  | 3.148 | 4.34* |
| AB               | 1  | 3.248 | 4.48* |
| AC               | 1  | .065  |       |
| BC               | 1  | .184  |       |
| ABC              | 1  | .051  |       |
| Error            | 52 | .725  |       |
| Total            | 59 |       |       |

\*  $p < .05$  - but not significant because at least .03 level required since the data was not distributed normally.

this will be discussed later. The study is also concerned with exploring further into other aspects of problem solving. The rest of the results will be with respect to notions which are not in terms of hypotheses but rather in terms of exploratory questions. Questions which we can ask of this data may have implications for future research.

The first question which we shall examine is: What effects, if any, does confirmation have on the particular parts of problem solving, namely, synthesis and analysis? The Doodlebug problem is unique in that we have a measure of the time a person spends analyzing the problem and also the time a person spends synthesizing the problem. Perhaps confirmation has some effect on either or both of these aspects.

The measures of analysis are the various times taken to overcome the three beliefs. Rokeach points out: "From the subject's verbalization and questions, it is relatively easy to tell at what point during the experiment he has overcome one or another belief by himself. For example, a subject might say: 'He can jump sideways, can't he?' 'Does he have to face the food in order to eat it?'" Such remarks were recorded by tape, and a time measure was obtained of how long it had taken for each subject to overcome the three beliefs of problem 1 and the two beliefs of problem 2. Each of these times represents the speed of analysis of each step of the problems. If the subjects did not overcome one or more of the beliefs, the time at which the hint was given was used to indicate the time they overcame the belief.

There are also three measures of synthesis. We cannot tell precisely when the synthesis process begins. We know that it can't



begin before the first belief is overcome because at that time the subject has nothing to integrate, but when afterwards does the synthesis begin? Rokeach suggests that it is likely that the analyzing and synthesizing processes overlap each other. Since we know the times taken for each subject to overcome each belief and the total solution time, we can obtain three measures of synthesis by subtraction. Following Rokeach these measures are:

- a. Time taken to solve the problem after the first belief is overcome.
- b. Time taken to solve the problem after the second belief is overcome.
- c. Time taken to solve the problem after the third belief is overcome.

Because we are not sure which of these is the best measure of synthesis time, we will examine all three.

Table 3 presents the mean analysis times, that is, the mean times taken to overcome one, two and all three beliefs. Because of the instructions, problem two had only two beliefs to be overcome. Examining these mean times, one can see that there appears to be no difference between the non-confirmation and confirmation groups in both problems. Chi-square median tests (Edwards, 1956) bears this out. The chi-squares for the analysis times for overcoming one belief and all three beliefs of problem one were less than one, and the chi-square for overcoming two beliefs was 1.64,  $p = .20$ . For problem two the chi-square for overcoming one belief was 3.58,  $p < .10$  and for overcoming two beliefs was less than 1. The median test was used because there was an excessive number of tied ranks.

For purposes of further exploration, a savings ratio was computed for the total analysis time. While the groups were not different with respect to time spent analyzing the two problems, perhaps there

TABLE 3

## MEAN ANALYSIS TIMES\*

|           | Groups           | Mean time to overcome: |            |               | Savings ratio<br>( $\frac{\text{Total analysis time of problem 2}}{\text{Total analysis time of problem 1}}$ ) |
|-----------|------------------|------------------------|------------|---------------|----------------------------------------------------------------------------------------------------------------|
|           |                  | 1st belief             | 2nd belief | all 3 beliefs |                                                                                                                |
| Problem 1 | Confirmation     | 3.90                   | 7.08       | 12.75         | .50                                                                                                            |
|           | Non-confirmation | 3.92                   | 7.56       | 13.34         | .62                                                                                                            |
| Problem 2 | Confirmation     | 2.36                   | 6.09       |               |                                                                                                                |
|           | Non-confirmation | 3.55                   | 6.96       |               |                                                                                                                |

\*These means are presented for comparison only and did not enter into the statistical analysis of the data.

was a difference in the time saved by the confirmation group as compared to the time saved by the non-confirmation group. The total analysis savings ratio was computed similar to the solution time ratio. Since the first problem had three beliefs to overcome and the second two beliefs, the ratio was:

$$\text{Total analysis ratio} = \frac{\text{total analysis time taken on problem two} \\ \text{(time to overcome two beliefs)}}{\text{total analysis time taken on problem one} \\ \text{(time to overcome three beliefs)}}$$

This ratio was computed for each subject. The means for each group is presented in Table 3. Again the groups were tested by using the Chi-square median test to see if they differed significantly. They did not; chi-square was less than 1.

Table 4 presents the synthesis times, the mean times taken to solve after overcoming the various beliefs. These times reflect the same differences found with the solution times, that is, through a quirk in sampling the subjects in the confirmation group were faster solvers because they could synthesize faster. The mean synthesis times were lower in the confirmation group than the non-confirmation group for both problems. These differences, however, were not significant as measured by the White's rank test. The results were as follows: For problem one: From the first belief,  $z = 1.61$ ,  $p = .11$ ; second belief,  $z = 1.20$ ,  $p = .22$ ; third belief,  $z = .80$ ,  $p = .42$ . For problem two: From the first belief,  $z = 1.28$ ,  $p = .20$ ; second belief,  $z = 1.29$ ,  $p = .19$ . Again, because of the sampling differences, a total synthesis savings ratio was determined for each subject. This ratio was similar to the ones devised for solution and analysis times. The total synthesis savings ratio was as follows:

TABLE 4

## MEAN SYNTHESIS TIMES\*

|           | Groups           | Mean time to solve after<br>overcoming |                          | Savings ratio<br>$\left( \frac{\text{Synthesis time of problem 2}}{\text{Synthesis time of problem 1}} \right)$ |
|-----------|------------------|----------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------|
|           |                  | 1st belief                             | 2nd belief all 3 beliefs |                                                                                                                 |
| Problem 1 | Confirmation     | 14.23                                  | 11.28                    | 5.41                                                                                                            |
|           | Non-confirmation | 19.32                                  | 15.68                    | 9.90                                                                                                            |
| Problem 2 | Confirmation     | 17.70                                  | 13.98                    | 3.65                                                                                                            |
|           | Non-confirmation | 23.84                                  | 20.08                    | 8.82                                                                                                            |

\*These means are presented for comparison only and did not enter into the statistical analysis of the data.

$$\text{Total synthesis savings ratio} = \frac{\text{synthesis time after overcoming two beliefs in problem two}}{\text{synthesis time after overcoming three beliefs in problem one}}$$

The means of this ratio for each group are presented in Table 4.

A White's rank test comparing the confirmation and non-confirmation groups was computed and showed that the groups did not differ significantly,  $z = .51$ ,  $p = .61$ .

One final time measure was obtained. This was the time between when the subject solved the problem and when he said that he was finished and turned the problem in. This time measure could be said to indicate how confident the subject felt about his solution. If he turned his solution in immediately after arriving at it, we could say he probably felt quite confident that it was correct, but if, instead, he waited 15 or 20 minutes we could say that he probably wasn't too sure of his solution and had to consider it for awhile before saying he was finished. Exploring again, with no a priori hypothesis, we might suspect that the subjects who did not receive confirmation on the first problem would be less sure of their answers on the second problem than those subjects who did receive confirmation. If this was the case, then the subjects who were not confirmed should take longer to turn their answers in on the second problem than those who were confirmed. Table 5 shows the mean solution to finish times for both groups. The groups did not differ significantly when tested with a White's rank test. Again, realizing that the groups were different to begin with, we need a relative score. A ratio similar to the ratios used previously was again constructed for each subject:

$$\text{Solution to finish savings ratio} = \frac{\text{solution to finish time of problem two}}{\text{solution to finish time of problem one}}$$

TABLE 5  
MEAN SOLUTION TO FINISH TIMES<sup>\*</sup>

|                                                                                                          | Confirmation<br>Group | Non-confirmation<br>Group |
|----------------------------------------------------------------------------------------------------------|-----------------------|---------------------------|
| Problem 1                                                                                                | 2.64                  | 3.80                      |
| Problem 2                                                                                                | 2.44                  | 3.32                      |
| Savings Ratio<br>( $\frac{\text{Solution to finish, Problem 2}}{\text{Solution to finish, Problem 1}}$ ) | 1.84                  | 4.92                      |

<sup>\*</sup> These means are presented for comparison purposes only and did not enter into the statistical analysis of the data.

The means of these ratios are presented in Table 5. When the two groups were tested for a difference with respect to this ratio they were found not to differ significantly,  $z = .29$ ,  $p = .77$ .

This concludes the results concerning time scores. For a summary of the analysis, synthesis, solution and solution to finish times refer to Table 6. The means of the analysis times plus the means of the synthesis times do not equal the mean solution times because the same subjects were not used to compute all the times. Due to mechanical and human lapses complete recordings were not available for all subjects. Complete recordings were available for 45 subjects and another 6 recordings were partial. There were no recordings for 9 subjects, making it impossible to obtain synthesis and analysis times. However, solution times were available for all subjects.

This next section of the results deals with a content analysis of the things the subject said during the solution of the problem. The verbalizations of the subjects were recorded. The following is the kind of information coded from the tapes:

1. Appeals. An appeal consisted of a subject asking either the confederate or the machine operator for some help or information. The appeal was always in the form of a question, (e.g. a subject might say: "Which way do you suppose Joe starts jumping?").
2. Hypotheses. A hypothesis was an attempted solution to the problem. The subject might try to get Joe to the food by having him start by jumping north, or by having him already two jumps west etc. Whenever a subject came up with a new idea on how to solve the problem this was coded as a hypothesis.

TABLE 6

## SUMMARY OF MEAN TIMES\*

| Groups           | Problem | Analysis<br>mean time<br>to overcome |               |        |                  | Synthesis<br>mean time to solve after<br>overcoming |               |        |                  | Solution<br>Time | Solution to<br>Finish time |
|------------------|---------|--------------------------------------|---------------|--------|------------------|-----------------------------------------------------|---------------|--------|------------------|------------------|----------------------------|
|                  |         | 1st                                  |               | all 3  |                  | 1st                                                 |               | all 3  |                  |                  |                            |
|                  |         | belief                               | 2nd<br>belief | belief | all 3<br>beliefs | belief                                              | 2nd<br>belief | belief | all 3<br>beliefs |                  |                            |
| Confirmation     | 1       | 3.90                                 | 7.08          | 12.75  |                  | 14.23                                               | 11.28         | 5.41   | 19.32            | 2.64             |                            |
| Non-confirmation | 1       | 3.92                                 | 7.56          | 13.34  |                  | 19.32                                               | 15.68         | 9.90   | 22.82            | 3.80             |                            |
| Confirmation     | 2       | 2.36                                 | 6.09          |        |                  | 17.70                                               | 13.98         |        | 18.92            | 2.44             |                            |
| Non-confirmation | 2       | 3.55                                 | 6.96          |        |                  | 23.84                                               | 20.08         |        | 25.46            | 3.32             |                            |

\* These means are presented for comparison only and did not enter into the statistical analysis of the data.



These were the only two measures which yielded enough data to analyze. Some of the other information we obtained from the recordings of the subjects were: 3. The subject repeating his particular problem; 4. The transfer of the total situation of the problem 1 to problem 2; 5. The transfer of the solution of problem one to problem two; and 6. The transfer of the hints of problem one to problem two.

The first information which we shall examine is appeals.

We might suspect that while confirmation has no effect on how long it takes a subject to solve a similar problem it might make the subject feel as though he needs more help from the confederate, or at least more agreement, if his solution to the first problem has not been confirmed. The subject who has received confirmation of his first solution may not feel he needs any more help solving the second problem. To test this notion we cannot compare directly the number of appeals the subjects in the confirmation group made with those made by the non-confirmed subjects for two reasons. First, we must consider what the chances are for a subject making many appeals. The factor which enters here is, of course, time. Those subjects who took 30 minutes to solve the problem would have a chance to make more appeals than those subjects who solved the problem in 10 minutes. To handle this we computed an appeal rate per minute for each subject for each problem. This rate controlled the time factor.

Secondly, we still cannot compare the rate of the confirmed subjects on problem two with the non-confirmed subjects because of the original differences between the two groups. In order to handle this we simply used a difference score. We subtracted the appeal rate of the subject on the second problem from the appeal rate of the subject on the first problem. With this final score we compared the

confirmation groups with the non-confirmation groups with a White's rank test and again found no differences,  $z = .40$ ,  $p = .69$ .

We also used another rate of appeals to see if confirmation had any effect. This was the appeal rate of the subject from the time he solved the problem until he turned the problem in. The appeals during this time were in the majority of the cases quite different than the appeals the subject made while he was working toward the solution of the problem. Once the subject arrived at the solution of the problem he wanted to know if the confederate thought this solution was correct, so he asked the confederate what he thought about it. The confederate would give such replies as "Gosh, I don't know." "I really couldn't say whether it's correct or not." etc. Subjects who were not confirmed on the first problem might well be expected to appeal more to the confederate for some confirmation after they had solved the second problem. To test this notion we subtracted the appeal rate of the time from solution to finish of the second problem from that of the first and tested the difference between the confirmation and non-confirmation groups with a chi-square median test, and found that the groups did not differ significantly. Chi-square was less than 1.

The next data with which we concerned ourselves are the hypotheses the subjects made during the solution of the problem. For each subject in the confirmation group we may think of him as making a variety of hypotheses and finally he makes one which he is rewarded for by it leading to the solution which is then confirmed. Does this confirmation in any way change his hypothesis rate on the second problem as compared to those subjects whose correct hypotheses were not confirmed? Again, to test this concept we had to control for time

because the longer the subject worked on the problem the more chance he had to make hypotheses. So a hypothesis rate for each subject for each problem similar to the appeal rate was computed. Next, the hypothesis rate for the second problem was subtracted from the hypothesis rate for the first problem for each subject. This difference score was then used to see if the confirmation group differed significantly from the non-confirmation group. They did not: White's rank test yielded a  $z = .29$ ,  $p = .77$ .

There is one final result which can be briefly mentioned and that is with respect to phone calls. The subjects were given the opportunity to make the phone calls to see if they had a strong desire for confirmation of their solutions. This measure turned out to be invalid because the confederate discovered from talking with many of the subjects that they thought they had to call as a part of the experiment, rather than just calling to find out what the correct answer was.

## DISCUSSION

We had hypothesized that the subjects whose solution to the first problem was confirmed would demonstrate a greater positive change than subjects whose solution was not confirmed. This hypothesis was not supported by the results. In no instance, either with the results of the time measures or the results of the content analysis, could we say that confirmation had an effect. In this experiment the lack of effect of confirmation was reliably demonstrated.

Why was no difference demonstrated? A variety of reasons may be offered to examine this and we shall now examine some of them.

One of the reasons for our results may have been the confederate. Even though it was the design of the experiment to have him appear as a non-authority, the subjects may have perceived him as an authority, and when he no longer rejected the subject's solutions in the non-confirmation group, it was the same as confirming them. Under these conditions we might expect both groups to be receiving confirmation and, therefore, not differing. Instead of the confederate acting in this consistent way perhaps there was some unknown effect being evoked by having the subject work with another person on the two problems. We might suspect that something like this occurred when we consider that the interaction between confederate and confirmation factors as measured by the analysis of variance (Table 2) approached significance. The effect of the confederate may have been such that it masked any effect of confirmation. Another explanation of the interaction and also the lack of difference between the groups may be the apparent non-randomness of the subjects.

Perhaps we had two very different groups, one which was effected one way by confirmation and the other effected in another way by non-confirmation, and when the amount of change of one was compared with the other we were asking the data a silly question which it could not answer. A reason why the groups were different originally could have been due to the non-confirmation group having mostly middle-high and high dogmatic subjects and the confirmation group having mostly middle-low and low dogmatic subjects. We found that the confirmation groups tended to synthesize more rapidly than the non-confirmation groups and the idea that dogmatism is the reason is tenable from Vidulich's (1956) work. He found that high dogmatic subjects took longer to synthesize the no-canopy Doodlebug problem than did low dogmatic subjects. If the non-confirmation group contained high dogmatics, we might have the subjects of this group looking toward the confederate as an authority since the dogmatic subjects have a need for authority in an ambiguous situation. When the confederate no longer rejected the dogmatic subject's solution, it may have been the same as confirming the solution. If this explanation were true, we would not expect a difference between the two groups in the amount of transfer.

Another reason which must be put forth to explain a lack of difference is that confirmation simply may not have any effect when we use "higher-level" problems. Earlier it was mentioned that "higher-level" problems are the kind which require an organization of past experience and the discovery of a new response as compared to tasks which require learning to repeat a particular response. Perhaps this productive type of learning which is accomplished in these "high-level" problems contains a certain amount of

self-confirmation. Perhaps the solver through the analysis and synthesis of the problem learns to depend upon himself for the solution and confirmation is self evident. Or perhaps, one simply does not have to know whether he is correct or not. This knowledge may not effect him one way or the other when he solves a similar problem. He may simply "learn how to learn" while solving the first problem irrespective of whether or not he has been confirmed.

There are some things wrong with these explanations. If all the subjects or even just the subjects in the non-confirmation group perceived the confederate as an authority, we would expect the groups to exhibit transfer. Oram has demonstrated transfer when the no-canopy problem is confirmed by a human authority. But our results do not indicate the same degree of transfer. Combining Oram's groups of high and low dogmatic subjects, we find that their mean times are 24.71 minutes for the no-canopy problem and 17.91 minutes for the canopy problem when it follows a confirmed no-canopy problem. Oram's mean time for the solution of the canopy problem when it was not preceded by a problem was 31.4 minutes. These results indicate a large amount of transfer. The mean time for both groups in our study were, the no-canopy problem, 20.82 minutes; the canopy problem, 22.19. Even though the mean time of the canopy problem indicates some transfer, the direction of the solution times with our problems is opposite to Oram's. Compared to the first problem Oram's groups took less time on the second problem. Our groups took longer on the second problem. If our subjects were receiving confirmation in the same fashion as Oram's, they should have behaved similar, but they did not. Furthermore, if confirmation is not necessary for a person to adopt to correct principles necessary to solve these "higher-level"

problems, why does Oram find evidence of a great deal of transfer and we do not? It seems that one thing is operating in Oram's study and another in ours. The previous notion about the unknown effect of the confederate is still tenable.

Another main difference between the present study and Oram's is that we had as our experimenter and authority the tape recorder, whereas Oram had a human. We can well expect that no intimate relationship developed between the tape recorder and the subject. The developing of a relationship between the authority and the subject might be quite important when examining the effects of confirmation with these types of problems. If the tape recorder was not perceived as an authority by the subject, the tape recorder telling the subject that he was correct might not be expected to have an effect. The thing which is important in the situation could be the live authority and not the confirmation, per se. The amount of transfer that did occur in our study may have been due to the confederate's confirmation by not rejecting the final solution, and the tape recorder's confirmation may have been irrelevant. This has certain implications. Knowledge of results is thought to be the important factor according to certain learning theorists, (Ammons, 1956), however, they do not suggest that knowledge of results is dependent upon whether or not a human gives it. If this interpretation is correct, they would predict the same amount of transfer in both Oram's study and also in our study. How would they explain the difference between our results and Oram's? They couldn't resort to the same explanation as is suggested by us because this would say that reward is contingent upon it being given by a person. It must be admitted that the above ideas are all after the fact and that they were derived from the data. The study was not

designed to oppose social psychological theory with learning theory, but the study simply suggests that the difference between human and non-human authorities would be an interesting area to examine. It's strange that this has not been studied previously since almost all experiments involve an authority present in the experiment. This authority is simply taken for granted and the willingness of subjects to co-operate, the dominant-submissive relationship that is present, and other variables deserve to be studied. The present study attempted to walk before crawling. The non-human confirmation was manipulated before finding out what the effect of the non-human confirmation was itself. Rather than answering any questions, this study asks the question:

What is the effect of confirmation by human authorities as compared to non-human authorities?



## SUMMARY

Two groups of subjects were given two similar Doodlebug problems to solve under two different conditions. Both groups of subjects had a tape recorder as an experimenter and an authority. One group of subjects was confirmed after they had solved the first problem and then given the second problem. The other group of subjects was not confirmed after they had solved the first problem and then given a second problem. The two groups were compared with respect to the proportion of time saved on the second problem. They were found not to differ significantly. Analysis and synthesis savings times were also compared and the groups did not differ significantly. A comparison of qualitative information derived from a content analysis of the subjects' conversations also yielded no differences. Also, this study did not show the degree of transfer which was demonstrated by a previous study using similar problems. It was suggested that perhaps a human authority is necessary before confirmation has an effect.

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