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The operant conditioning of a social response

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Boston University

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1961
THE OPERANT CONDITIONING OF A
SOCIAL RESPONSE

by
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I wish to thank Dr. Chester C. Bennett and the other members of my committee, Mr. Charles N. Leef and Dr. Garry Margolius for their help and encouragement in the preparation of this dissertation.

Having lived with this project for nearly three years, few of my friends have been spared a share in its burden. The Zolas, Irving and Lee, have given a careful and critical hearing to much of the material. In the earliest stages, Mrs. Marilyn Glass and Dr. Warren G. Bennis helped to sort out my thinking on several important points and provided much of the enthusiasm which has sustained it.

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TABLE OF CONTENTS

CHAPTER                      PAGE

I.  THE MEANING OF SOCIAL RESPONSE.......................... 1

II. SOCIAL RESPONSE AND CONVERSATION.......................... 5

III. THE OPERATIONS AND PROCEDURES OF THE EXPERIMENT..................... 16

IV. THE EXPERIMENTAL PREDICTIONS AND THE STATISTICAL HYPOTHESES.............. 21

V.  RESULTS AND DISCUSSION........................................ 24

   The First Experiment..................................... 25

   A Replication............................................. 31

   A Second Replication...................................... 36

VI. CONCLUSIONS.................................................. 42

VII. SUMMARY.................................................... 46

APPENDIX A
   The Geography of the Experimental Room... 52

APPENDIX B
   Observer Reliability................................. 53

REFERENCES.................................................... 58

ABSTRACT....................................................... 59

AUTOBIOGRAPHY.................................................. 63
<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The frequencies of the various trial outcomes</td>
<td>26</td>
</tr>
<tr>
<td>in the first experiment</td>
<td></td>
</tr>
<tr>
<td>2. The percentage of all two-person trial endings</td>
<td>29</td>
</tr>
<tr>
<td>in trials where there was a conversation during the first experiment</td>
<td></td>
</tr>
<tr>
<td>3. The frequencies of the various trial outcomes</td>
<td>33</td>
</tr>
<tr>
<td>in the first replication</td>
<td></td>
</tr>
<tr>
<td>4. The percentage of all two-person trial endings</td>
<td>34</td>
</tr>
<tr>
<td>in trials where there was a conversation during the first replication</td>
<td></td>
</tr>
<tr>
<td>5. The frequencies of the various trial outcomes in the second</td>
<td>37</td>
</tr>
<tr>
<td>replication</td>
<td></td>
</tr>
<tr>
<td>6. The percentage of all two-person trial endings</td>
<td>40</td>
</tr>
<tr>
<td>in trials where there was a conversation during the second replication</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER I

THE MEANING OF SOCIAL RESPONSE

The experiment described in this paper is an attempt to further our understanding of social behavior by bringing a portion of that behavior under experimental control. The spirit of the theoretical basis underlying this research is expressed nicely by Skinner:

We are concerned here simply with the extent to which an analysis of the behavior of the individual which has received substantial validation under the favorable conditions of a natural science may contribute to the understanding of social phenomena. To apply our analysis to the phenomena of the group is an excellent way to test its adequacy, and if we are able to account for the behavior of people in groups without using any new term or presupposing any new process or principle, we shall have revealed a promising simplicity of the data.1

The "analysis" Skinner refers to is embodied in the two laws of operant conditioning:

The Law of Conditioning of Type R: If the occurrence of an operant is followed by presentation of a reinforcing stimulus, the strength is increased.

The Law of Extinction of Type R: If the occurrence of an operant strengthened through conditioning is not followed by the reinforcing stimulus, the strength is decreased.2

Although there has been no broad program of research devoted to the study of operant conditioning in a group set-

ting, several studies have been carried out which do bear on the question.

Skinner,\(^3\) in a demonstration experiment, has trained pigeons to behave in a leader-follower relationship. Two pigeons are placed in adjacent cages. In front of each subject is a vertical panel containing three buttons. At any moment only one of the three buttons will produce reinforcement when it is pecked; the payoff button being determined on a random schedule. The device is programmed so that reinforcement occurs only if both subjects peck the payoff button at the same time.

The effect of this experimental procedure is that one of the subjects hunts through the buttons searching for the payoff, while the other subject observes the behavior of the first and mimics it. This joint behavior is compounded of the responses of one organism which are controlled primarily by environmental cues and the responses of another organism which are controlled by social stimuli. Skinner would characterize the former as leader behavior and the latter as follower behavior.

Azrin and Lindsley\(^4\) have carried out a similar experiment with human subjects. Using jelly beans as a reinforcer, using jelly beans as a reinforcer,

---

they conditioned a cooperative motor response in two-person groups of children. The subjects, without any verbal instructions, were seated at the opposite sides of a table. Each subject was given a stylus, and a board with three holes was placed in front of him. Paralleling the procedure of the Skinner demonstration experiment, reinforcement was given whenever both subjects placed their styli in corresponding payoff holes. This procedure effected an increase in the rate of the cooperative response.

In both of these studies a response was built up which placed the behavior of the group under the control of discriminative stimuli provided by the group itself.

At present Bachrach, Candland and Gibson are investigating the effects of group reinforcement upon the responses of individuals. The response class they are studying is the amount of time an individual speaks. Reinforcement is in the form of verbal expressions of approval and disapproval, delivered by either or both of two role players in their three-person groups.

The essential core of meaning that seems to run through the Skinner and the Azrin and Lindsley experiments can be characterized in at least two ways. It can be seen as a number of individual responses united in a

special way or as a response made by a group as a whole which is analyzable.

One convenient way to formulate it is as a "social response". A social response is a discriminated operant which includes the behavior of more than one organism in a group and is at least partly under the control of stimuli produced by the group itself.

Thus, in the Skinner experiment, the simultaneous pecking of the pigeons is the social response. The behavior of the follower bird is functionally related to the reinforcement, while the behavior of the leader bird provides an intrinsic part of the stimulus conditions which are the occasion for the follower's response. Similarly in the Azrin and Lindsley experiment simultaneous stylus placement is the social response. In this experiment the elements of the social response do not appear to be divided so clearly between the subjects. Yet in every single occurrence of the response, it should be possible to identify some of the behavior as "discriminative stimulus" and some as "response".

The use of the word "simultaneous" in this context is not quite accurate. Since in both experiments the behavior of at least one subject is taken as a discriminative stimulus for the other subject, what is involved is really a sequential process. What appears to be simultaneous in time is really sequential in terms of the psychological processes involved.
CHAPTER II

SOCIAL RESPONSE AND CONVERSATION

The notion of a social response is easily extended to verbal behavior. In any conversation a number of individuals are present and to a great extent are using one another's responses as discriminative stimuli for their own behavior. There are circumstances where this is especially clear. In the bidding period of a bridge game, at an auction, in the performance of a play, the verbal responses of an individual are clearly dependent on the responses of the others present.

In informal groups this contingency is harder to demonstrate, but in every gathering of humans at least some aspect of the behavior occurring can probably be accounted for in this way. So long as a conversation is being held, it is necessary for the conversants to speak in some order; and this serial order of speakers in a conversation is the behavior the present research is designed to bring under experimental control. What is required is an experimental procedure that will maximize the opportunity for this social response to develop.

The procedure that was adopted for this purpose re-
sembles the techniques used by Greenspoon, Verplanck and others working in the area of learning without awareness. The substantive findings of these and other studies are summarized in recent review articles by Adams and Krasner and are subjected to a careful critical estimate in papers by Goldiamond and Eriksen. What is of primary interest here is the methodology of these studies. Typically subjects are given very minimal instructions designed to narrow down the range of their emitted behavior. In the Greenspoon study the subjects were asked to say all of the words they could think of, omitting phrases. Verplanck has tried out a variety of different instructions.


ranging from telling sophisticated subjects that they were being conditioned to giving no verbal instructions at all.

Once the experiment proper begins, E presents the reinforcing stimulus whenever S makes a predesignated response. Greenspoon using the phrases "mmm-hmm" and "huh-uh" as reinforcers conditioned subjects to utter more plural nouns. Verplanck, using a pencil tap or "good" has conditioned a variety of motor and verbal behaviors. Both of these investigators and others as well report a significant behavior change even when subjects did not verbalize, either during or after the experiment, the contingency between response and reinforcement. Sidowski 12 carried out an experiment similar to the Greenspoon study substituting reinforcement by a blinking light for the direct intervention of the experimenter, with similar results.

The procedure of this experiment as it is developed below will be seen to be similar to that used in these studies and the data are, of course, interpretable in the same context.

In the most general terms this research is concerned with the relationship between reinforcement and a social response. The particular social response to be studied is the serial order of speakers in a conversation. An hypothesis entailed by reinforcement learning theory is that

the frequency of a particular sequence of speakers selected from the possible sequences will increase under conditions of positive reinforcement and will decrease when it is permitted to occur in the absence of the reinforcement.

The most direct translation of this hypothesis into experimental terms calls for a free conversation among several subjects which is interrupted from time to time by reinforcement. Thus a group of, say three subjects, might be instructed that from time to time a light will blink and that the number of blinks they will receive is contingent on something they do. Such a group might be expected to carry on a continuous conversation about what this contingency might be. And this is exactly what did happen in a pilot experiment. At times the content of the conversation seemed to stray from this objective, but it was a fairly continuous flow of conversation, and that is all that is required.

A complete record of such a conversation where the speakers are designated "A", "B" and "C", ignoring content and length of speech, might look like this:

ACBCABACBCABCACBCABCA...

Now it is possible to treat some recurrent property of this sequence as a response and to reinforce it. For example, every two person sequence AB might be followed by the presentation of the reinforcing stimulus. If AB had been selected in this example the group would have received
three reinforcements during the above sequence. The hypothesis might be tested by comparing the number of blinks during the first five minutes of the conversation with the number in the last five minutes.

Such a procedure is elegant, but for several reasons it is not feasible. The most compelling among them is the difficulty of obtaining an accurate record of the sequence, using human observers. Agreement between two observers who recorded three item sequences in a pilot experiment was 29%. This figure would probably be considerably lower if only a fourth item were added to the sequence, let alone the hundreds of items that would result from the procedure outlined above.

It was clear in the early stages of this research that a test of the hypothesis would be possible only with a substantial departure from the simplest operational translation. The procedure used was by no means strictly entailed by the general hypothesis but was rather a method which was developed empirically from it. At each of a number of points in this development choices were open to the experimenter as to which direction to take and these choices were resolved in a manner consistent with the general strategy of maximizing the opportunity for the social response to develop. As a result, parts of this discussion appeal to principles of learning that may appear to be out-
side of the vocabulary of operant conditioning strictly conceived, but are in every case consistent with it.

The general plan was to ask the group to make a series of unanimous decisions, to become silent as soon as each consensus was reached, and to wait silently to discover whether or not their decision was correct.

The reason for compelling unanimity should be clear enough. Even though a group response was being conditioned, the separate motives of three individuals were being dealt with and some means had to be devised of bringing these motives into harmony. It was important for them to reach a single decision in order to make the meaning of "correctness" unambiguous. In principle it is possible to choose a group whose motives with regard to some set of issues is known in advance to be similar. It was possible, for instance, to work with groups of college students discussing tuition costs, final exams, etc. or groups of negroes discussing segregation in which cases it is possible to know with some certainty that there will be considerable agreement around special issues. It would have been very difficult, however, to invent enough discrete issues to produce a discussion of sufficient length to permit a test of the hypothesis. Moreover, since the correctness of the group's opinions is not contingent on the strength of the facts in their favor it is almost inconceivable that enough rationalisations could be found to
justify the number of occasions when the group would be in-
formed that its consensual opinion was incorrect.

The key to this problem seemed to rest in choosing
subjects whose opinions and attitudes were in fair accord
in a very general way and in asking them to make decisions
about a set of issues that were vague enough or ambiguous
enough to permit any sort of experimental intervention
without disturbing verisimilitude, and interesting enough
to keep the group at work during long experimental sessions.

A task that meets these requirements is suggested by
extra-sensory perception, or more particularly telepathic
communication. It is not difficult to find subjects who
are fairly sympathetic or at least not antagonistic towards
such phenomena. The general outline of this kind of experi-
ment is generally known, so that the procedure could be
made to match the subjects' advance expectations. Justi-
fication for a reply of correct or incorrect need hardly
be thought about since the phenomenon is acknowledged to be
purely subjective. And the appeal of such a task for many
subjects is evident.

Once having decided to use ESP in this way a number
of choices had to be made. What sort of messages should
the group communicate? How many messages should they be
asked to choose among? Should their role be as senders
or receivers of the messages?

Several kinds of messages were tried in a series of
pilot studies and the communication of color names proved to be convenient.

The second decision was not arrived at so easily. There are two sets of probabilities in this experimental situation which have to be considered together. First, there is the rate of the social response. Since the experiment consists of a series of discrete trials the probable rate of particular sequences of speakers can be estimated in advance of the experiment. Another set of subjective probabilities is generated by the number of possible messages the group is asked to select from in making their decisions. Suppose that the social response had the expected rate of ten in one hundred trials, while the group had to choose from among two messages. Their subjective estimate of chance expectancy, assuming that they were familiar with the laws of probability and assuming also that they were perfectly rational, reckoned from the number of messages would be one half. But since the ratio of correct to incorrect trials is really a function of the rate of the social response they would be correct in only about one out of ten trials.

At the beginning of such an experiment they would feel that they were very unsuccessful and even if such an experience was not too disruptive to prevent conditioning from taking place this feeling would remain after the rate of the social response had doubled or tripled.
The opposite subjective effect of course would be obtained by reversing the magnitude of the two probability estimates. Thus, with many messages to choose from and a social response with a high probability of occurrence the group would experience success while achieving failure.

Now, there is no reason implicit in the experimental hypothesis why the group must have a realistic estimate of its achievement. But as a matter of fact the group's appraisal of itself does have an effect on its behavior. In pilot studies both of the extremes of inaccurate group self appraisal seemed to affect performance.\(^\text{13}\) When groups saw themselves as performing badly they behaved disruptively to the point of being difficult to observe reliably. When the task was seen as an easy one they sometimes restructured the situation and tried to communicate incorrectly because the incorrect signal "sounds better".

The most obvious solution is to match these two sets of probabilities precisely, that is if the selected social response has the probable rate of one in six then the group might be given six messages to choose from. For some groups the initial experience under this arrangement is one of failure and sometimes has led to disruptive, hence, unobservable behavior, but in the present case with well-

motivated, cooperative subjects it was felt to be the best compromise from the point of view of preserving the cooperation of the subjects throughout several experimental sessions during which changes in the rate of the social response were expected.

The decision whether to instruct the subjects that they were sending or receiving messages was made without benefit of data but with some forethought. It was reasoned that if their role were conceived as a passive, receiving one, their job would be ended as soon as they reached consensus. The necessary delay before reinforcement would be simply a slightly annoying time lapse. If, on the other hand, the group felt that they were sending messages the delay before reinforcement would appear to them to be an essential part of their job during which interest and silence would be maintained.

The procedure outlined so far has the intent of producing a series of short discrete conversations each ending in consensus and separated by periods of complete silence. The schematic record of such an experiment might look like this:

<table>
<thead>
<tr>
<th>TRIAL</th>
<th>SEQUENCE</th>
<th>DECISION</th>
<th>DELAY</th>
<th>EXPERIMENTAL INTERVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ACBAC</td>
<td>red</td>
<td>Silence</td>
<td>incorrect</td>
</tr>
<tr>
<td>2</td>
<td>BCACBA</td>
<td>green</td>
<td>Silence</td>
<td>incorrect</td>
</tr>
<tr>
<td>3</td>
<td>CAB</td>
<td>red</td>
<td>Silence</td>
<td>correct</td>
</tr>
</tbody>
</table>
From the point of view of the experimenter the important contingency is between the sequence and the experimental intervention. The nature of the experimental intervention is dependent on some recurrent property of the sequence, which is the particular social response to be studied. The problem now is to select a property that is convenient for that purpose. It has been established already that reliable observation is limited to sequences two speakers in length, which places a restriction on the selection.

It was decided to treat the final two speakers in each trial as the set of social responses from which the particular social response was drawn. This was in keeping with the general research strategy of maximizing the opportunity for the response to develop. Thus, consistent with the principle of contiguity, the delay between response and reinforcement was kept at a minimum and complete motor inactivity was encouraged during it.

A mechanical apparatus, which made the group's task more concrete, was introduced into the experimental situation with the purposes of promoting a distinct end to each trial and of enforcing silence during the delay between response and reinforcement.
CHAPTER III

THE OPERATIONS AND PROCEDURE OF THE EXPERIMENT

The Apparatus. The experimental apparatus consisted of a circular table upon which there was a circular array of six colored lights. At each of three approximately equidistant points toward the edge of the table there was a small black box on the upper face of which there was a circular array of six buttons identical in color and order to the lights in the center of the table.

The subjects were seated around the table at random before each of these boxes. A light would go on only if all three buttons of that color were pressed. It would remain on as long as all three buttons were held down.

On the other side of a one-way screen, three other components were wired into the system. When a light was turned on a mechanical timer was triggered off which after a three second delay activated a two position switch. One position of the switch was connected to a code practice oscillator which produced a constant tone, the other pole was connected to an ordinary door buzzer.

The instructions called for the subjects to turn on a light under certain conditions and to keep it on. After a lapse of three seconds they were presented with a sound automatically. During the delay it was possible for the
experimenter to select, on the basis of the group's behavior or before the delay, whether the tone or the buzzer was to be sounded.

The Subject's Instructions. "As you know, this is an experiment in extra-sensory perception. We are studying the effectiveness of thought transference when it is carried on by a group of people. In a moment I will explain more about it but first I want you to get used to these lights and buttons, since they will be used in the experiment. In order to turn on a light all three buttons of that color have to be pressed. The light will stay on as long as the buttons are held down. Try the red light. (They do.) Now turn it on again and keep it on for a while. (They do.) Good.

"Besides the three of you there is another person in this building who is taking part in the experiment. He has with him another set of buttons just like yours and it is his task to receive messages that you will send to him.

"It is your job to talk it over and decide which one of these six messages you feel is the most 'sendable' at the moment. Try to relax and let your intuition guide you. As soon as you all agree on a color you are to stop talking immediately, turn on that light, keep it on and concentrate on it while remaining absolutely silent until you learn whether or not your message was received."
"I will be watching the experiment from behind that screen. When I see your light go on I will signal the receiver that you are trying to send. The receiver will have a few seconds to try to receive. When he thinks he has the answer he will press one of the buttons on his control box. If it matches your light you will hear a sound like this (tone). If his selection does not match yours you will hear this (buzzer).

"Either of these sounds is the signal for you to turn off your light and to select another message. This will continue until I come back into the room and stop the experiment."

The Response. The data consist of seven blocks of one hundred trials collected on each of seven consecutive days. The end of a trial is marked by the group's unanimous decision signified by a light being turned on. The next trial begins immediately after the cessation of the tone or buzzer. In recording the sequence of speakers attention was paid only to the last two speakers in each trial. Assuming that the identity of the speaker changed at least once during a trial, each trial has six possible outcomes, AB, AC, BA, BC, CA and CB.

One of these outcomes, AB, was chosen as the social response to study. Independent records of the final two speakers in each trial were kept by two observers. Because the flow of conversation was rapid at times, and be-
cause of simultaneity or near simultaneity of speakers
several criteria for resolving ambiguous cases, some
strictly conventional, were worked out during the course
of pilot studies. These criteria were:

1. Any communicative utterance regardless of length
is a speech. The affirmative "mmm-hmmm", the negative "unh unh", the interrogative "hmmm?" were ad-
missable when they were inflected appropriately. Non
verbal communication, even vigorous head shakings and
noddings were not accepted as responses. Sounds which
did not seem to be intended consciously as communica-
tive acts like coughing and spontaneous laughing were
not responses.

2. A change in speakers is recorded regardless of
whether it is an interruption or is preceded by si-
lence. If B interrupted A with a short comment and
A continued his speech, the sequence was recorded as
"ABA".

3. When there is more than one subject speaking sim-
ultaneously at the end of the trial the last subject
to finish speaking is the final speaker. The subject
who finishes speaking next to last is the penultimate
speaker.

4. Any utterance that occurs after the light is on
is disregarded.
Subjects. Two three-person groups of men and one three-person group of women were the subjects in this study. Each subject was screened in an individual interview where it was determined that he or she was not color blind, spoke distinctly, and was not totally negative towards extra-sensory phenomena. The subjects were strangers to one another before the experiment.
CHAPTER IV

THE EXPERIMENTAL PREDICTIONS AND THE STATISTICAL HYPOTHESES

Before turning to a discussion of the experimental findings it may be useful to review the major theoretical issues which so far have been developed informally, and to indicate the specific demands that these theoretical considerations place upon the data of this study.

The aim of this study was to discover if a social response could be brought under experimental control. Experimental control would be demonstrated if a social response behaved in the laboratory in a way similar to other learning phenomena. Under conditions of positive reinforcement the rate of the response should increase. When subsequently, the response was permitted to occur in the absence of reinforcement it should decrease in frequency.

The independent variable in this experiment is reinforcement which took the form of a tone and a buzzer, interpreted to the subjects as successful and unsuccessful telepathic communication, respectively. Reinforcement was presented under three separate conditions.

1. Operant condition. During the first two days of the experiment the positive reinforcing stimulus was presented after one-quarter of the trials in a random order.

2. Learning condition. On the third, fourth and
fifth days of the experiment every trial with the outcome AB received positive reinforcement.

3. Extinction condition. During the final two days of the experiment positive reinforcement was given only after trials with some particular outcome other than AB; in this case BC.

The dependent variable in this experiment is the number of trials with the outcome AB. The rate of this response was expected to vary as a function of the three stimulus conditions. The two laws of operant conditioning cited in Chapter I entail two formal predictions with respect to this experiment:

1. The rate of AB will be greater during the learning condition than during the operant condition.
2. The rate of AB will be greater during the learning condition than during the extinction condition.

One way to test these predictions is to compare the average rate of AB within each of the three periods. However pilot studies suggest that the experimental conditions require a number of trials in order to establish themselves. If this is the case the effect of the experimental conditions might be lost if the early part of each condition is included in the average. All that is required to test the predictions is a sample of behavior under each condition.

For this reason, the final day of the learning condition and the final day of the extinction condition, where
the height of the effect ought to be present were chosen as the data to be used to test the statistical hypothesis.

The three parts of the experiment that are considered statistically, then, are the first and second day, the fifth day, and the seventh day. The test statistic is $\chi^2$ for two independent samples. $\alpha = 0.05$.

The test hypothesis for prediction 1 is that the rate of AB during the first two days of the experiment is equal to the rate of AB during the fifth day, which is tested against the one-sided alternative: the rate of AB during the fifth day is greater than the rate of AB during the first two days.

The test hypothesis for prediction 2 is that the rate of AB during the fifth day is equal to the rate of AB during the seventh day, which is tested against the one-sided alternative: the rate of AB during the fifth day is greater than the rate of AB during the seventh day.

In order to establish a logical justification for assertions about the relationship between the experimental variables, as distinct from the particular subjects employed in the experiment, these procedures were carried out on three separate groups.
CHAPTER V

RESULTS AND DISCUSSION

The results of these three experiments offer support for the general hypothesis. Two of the three groups showed a statistically significant conditioning effect. The extinction effect was significant in one of these groups and showed a nonsignificant trend in the expected direction in the other one.

The third group did not reveal any large apparent changes through the fifth day, so the extinction period was omitted and conditioning was continued for four additional days, without apparent effect.

Although the instructions were written with the intent of producing a short conversation in every trial, this was not always the case. When trials where fewer than two subjects spoke are omitted from the analysis and the reinforced response is considered as a percentage of the trials that contained conversations, the results for all three groups are more nearly a match with the hypothesized distribution.

Since there were some interesting differences in their behavior, the results of the three group experiments are reported and discussed separately.
I. THE FIRST EXPERIMENT

The results of the first experiment are summarized in Table 1. The rows of the table represent the seven days of the experiment and the columns represent all the possible trial outcomes. The first six columns refer to the last two speakers in a trial. The columns headed A, B, and C identify the speaker in trials where only one person spoke. The other categories respectively refer to trials where observation was not possible, where the groups' decision was reached through non-verbal communication and where there were apparent ties.

Inspection of the AB column reveals a four day period without apparent change in the response rate extending through the first two learning days. On the fifth day AB occurred thirty times compared to 8.5 on the greater of the two operant days.\(^{14}\) The extinction period evidences a decline in the response rate to 13.5, a level between the height of the learning and the lowest point of the operant period.

In order to test prediction 1, \(\chi^2\) was calculated, using 14.5, the sum of AB for days one and two, and 30,

\(^{14}\) The fraction that appears here and elsewhere in this report are the result of the recording procedure used. All results are based on the daily average totals in each category of two independent observers. See Appendix B for a summary of inter-observer agreement.
Table 1

THE FREQUENCIES OF THE VARIOUS TRIAL OUTCOMES
IN THE FIRST EXPERIMENT

<table>
<thead>
<tr>
<th>Day</th>
<th>AB*</th>
<th>AC</th>
<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>No Record</th>
<th>No One</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operant Period</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>1</td>
<td>8.5</td>
<td>4.5</td>
<td>2</td>
<td>13</td>
<td>1</td>
<td>38</td>
<td>4.5</td>
<td>16</td>
<td>13</td>
<td>1.5</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>3.5</td>
<td>2.5</td>
<td>15.5</td>
<td>4.5</td>
<td>34</td>
<td>2.5</td>
<td>20.5</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
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<td>Conditioning Period</td>
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<td>1</td>
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</tbody>
</table>

* AB was the contingent response
the number of occurrences of AB during the fifth day, as the observed frequencies of AB. The table was filled out with 185.5 and 70, the number of non-AB occurrences during the two test periods. The obtained $\chi^2$ value corrected for continuity was 25.54. Since this value exceeds $\chi^2.95$ with one degree of a freedom, the test hypothesis may be rejected in favor of the one-sided alternative: the rate of AB is greater during the fifth day than during the first two days.

The $\chi^2$ test for prediction 2 was calculated in the same manner, taking 30 and 13.5 as the observed frequencies of AB, and 70 and 86.5 as the observed frequencies of non-AB. The obtained $\chi^2$ value with one degree of freedom corrected for continuity was 7.06. Since this value exceeds $\chi^2.95$ with one degree of freedom, the test hypothesis may be rejected in favor of the one-sided alternative: the rate of AB is greater during the fifth day than during the seventh day.

The apparent changes in response rate are statistically reliable with respect to both learning and extinction.

The possibility remains that these changes in the rate of the AB outcome were not associated with the learning of a social response, but rather with changes in individual rates of responding. If A or B or both A and B learned to speak more often this indirectly would have increased the rate of the AB outcome.
However, the interpretation of the results on the basis of individual frequencies implies that the same changes be observed in the rate of the BA outcome, since this response contains the same elements as the AB response. Such an interpretation would predict that at the height of the learning period there be no difference between the rates of AB and BA. The observed value of AB on the fifth day is 30 and the observed value of BA on the fifth day is 7.5. The expected value in both cases is given by

$$\frac{30 - 7.5}{2} = 18.75$$

The resultant $\chi^2$ is 13.50 which, with one degree of freedom, exceeds $\chi^2$ at the five percent level. The hypothesis that the obtained difference in the rate of AB is a function of changes in individual response rates is not supported.

The changes in the day to day record of the AB outcome, although never in a direction counter to the conditioning hypothesis, do not become striking until the fifth day, when there is a spurt from 8.5 to 30. The discontinuity of the acquisition is not alarming in the light of the size of the difference. However, a more orderly increase would place the results of this experiment more clearly in the class of typical learning phenomena.

When the data are recast, as they are in Table 2, a more orderly result is obtained. This table considers
TABLE 2

THE PERCENTAGE OF ALL TWO-PERSON TRIAL ENDINGS IN TRIALS WHERE THERE WAS A CONVERSATION DURING THE FIRST EXPERIMENT

<table>
<thead>
<tr>
<th>Day</th>
<th>AB*</th>
<th>AC</th>
<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
<th>TOTAL</th>
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<td>213</td>
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<td>5</td>
<td>23.5</td>
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<td>52</td>
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<td>66</td>
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<td>3</td>
<td>12</td>
<td>16</td>
<td>10</td>
<td>18</td>
<td>7</td>
<td>39</td>
<td>100%</td>
<td>51</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>8</td>
<td>14</td>
<td>8</td>
<td>4</td>
<td>34</td>
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<td>26</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>17</td>
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<td>10</td>
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<td>25</td>
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<td>90.5</td>
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<td>28</td>
<td>16</td>
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<td>17</td>
<td>8</td>
<td>26</td>
<td>100%</td>
<td>77.5</td>
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<td>7</td>
<td>18</td>
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<td>18</td>
<td>28</td>
<td>100%</td>
<td>74</td>
</tr>
</tbody>
</table>

* AB was the contingent response.
only those trials where two or more individuals spoke.

The numbers in the body of the table represent the percentage of particular two person outcomes out of all two person outcomes for that day.

When the data are examined in this way the height of the learning appears to have occurred on the fourth day and to have maintained itself during the last learning day.

Although both Tables 1 and 2 contain too many inter-contingencies to admit of a systematic analysis of the details of the response learned by the group, there are several trends which deserve mention. The day to day record of AC appears to parallel at a lower magnitude the changes in the AB response. This might suggest that A, who appears as the penultimate speaker in both outcomes, accommodated himself to the requirement of the social response to a greater degree than B or C.

The choice of BC as the alternate response to be reinforced in the extinction period was simply one of convenience. In terms of its elements and their order, it seemed to be different enough from AB to allow discrimination and similar enough to admit of transfer. Its frequency on the fifth day which was neither very high nor very low helped to determine its choice for this purpose. As a matter of fact the results of the final three days show the same kind of trend evidenced in the acquisition of the AB response.
The results of experiment 1 reveal a statistically significant increase in the rate of the social response under conditions of positive reinforcement and a significant decrease in its rate when the response was permitted to occur in the absence of positive reinforcement.

II. A REPLICATION

A second experiment was conducted similar in all essential details to the first one, with the following exceptions:

1. The social response to be conditioned was not chosen at random. In experiment 1 the response conditioned comprised the individual who spoke least frequently during the operant period as penultimate speaker and the person who spoke most often as ultimate speaker. While the selection of AB had been made at random, it was felt that this factor might have been a factor in producing the results. In advance of experiment 2 it was decided that the social response to be conditioned would comprise as ultimate speaker that individual who spoke least in the operant period and as penultimate speaker, that individual who spoke most.

2. The general attitude of the group seemed to be considerably less sympathetic toward extra psychic phenomena.
The results of this experiment are presented in Table 3. The rate of AB was 15 and 11.5, respectively, on the two days of the operant period. Since no apparent increase was produced during the three days planned as the learning period, the decision was made to continue the learning schedule during the interval planned as extinction. When learning did not take place during days six and seven, the group was asked to return for two additional days.

As an added incentive on these final two days the group was told that for each correct response they would be given a nickel. This effort met with no apparent success.

When the AB response is considered as a percentage of the aggregate of two person responses for each day as it is in Table 4, a trend in the predicted direction is observed during the first three learning days. The rate of AB seems to increase gradually from 17% during the operant period to 29% on the fifth day. Following this the response rate falls steadily, in spite of the fact that the conditioning schedule was maintained.

The results of this experiment are equivocal at best. Although there may be a slight learning trend, what remains to be explained is the general failure of the experimental conditions to produce the predicted effect.

Such an explanation may be sought in the differences that exist in the conditions of the two experiments. Two
TABLE 3

THE FREQUENCIES OF THE VARIOUS TRIAL OUTCOMES
IN THE FIRST REPLICATION

<table>
<thead>
<tr>
<th>Day</th>
<th>AB*</th>
<th>AC</th>
<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<th>No Record</th>
<th>One</th>
<th>Other</th>
<th>Total</th>
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<tbody>
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</table>

* AB was the contingent response.
TABLE 4

THE PERCENTAGES OF ALL TWO-PERSON TRIAL ENDINGS IN TRIALS WHERE THERE WAS A CONVERSATION DURING THE FIRST REPLICATION

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<th>Day</th>
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<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
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<td>100%</td>
<td>62</td>
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</tbody>
</table>

* AB was the contingent response.
such differences have been alluded to already. The differences in the individual response rates evidenced in the operant period may be critical. It is possible that this social response can only be conditioned or may be conditioned most readily when the penultimate speaker has the lowest individual response rate.

Another possibility lies in the strength or the meaning of the secondary reinforcer. Two of the subjects in this group were outwardly critical toward the experiment, and the third registered some serious scepticism. In contrast, the collective attitude of the subjects in experiment 1 was decidedly positive. In their behavior during the experiment the first group concentrated at all times upon the task of choosing subjectively sendable messages, whereas the second group often made arbitrary color choices. At times the subjects would take turns in telling anecdotes where each sentence was associated to a particular color and this association led to that color's selection. Also at times, during the course of the second experiment the opinion was expressed openly that this was not really an experiment in extra-sensory perception, but that something else determined whether they were right or wrong.

There is no satisfactory way of weighting these alternative explanations for what is essentially a negative result. However, they suggest testable hypotheses which may be investigated independently of the present research.
III. A SECOND REPLICATION

The experiment was replicated on a third group. The subjects in this experiment were three women. Whereas in the first group the two person outcome to be reinforced was selected at random and in the second group it was determined by an a priori criterion, in this group the choice was made in an empirical fashion after the two operant days in a manner to be described below. In all other respects the conditions of this experiment were identical with those used in the first experiment. 15

After the operant days were completed the record was inspected and the decision was made to reinforce BA. First AC and CA were eliminated because their rate appeared to be too high. The other two-person outcomes were also scrutinized and were rejected either because they showed an increase between the first and second day or because their rate seemed too low. BA survived the elimination because it was at a moderate level and had shown an apparent decline during the second day.

The results of this experiment are reported in Table 5. The day to day record of the BA outcomes shows an apparent increase during the three days of the learning period with a peak of 34.5 on day four, as compared with 13 on the higher of the two operant days. In the extinction period

15. The naming of the subjects in all three experiments is in constant relation to the seating arrangement, which is described in Appendix A.
### TABLE 5

THE FREQUENCIES OF THE VARIOUS TRIAL OUTCOMES
IN THE SECOND REPPLICATION

<table>
<thead>
<tr>
<th>Day</th>
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<th>CA</th>
<th>CB</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<th>No</th>
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<th>Total</th>
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<td>17.5</td>
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<td>6</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

* BA was the contingent response.
the rate of BA shows a decline to 16.5 and then a slight increase to 18.5.

In order to test prediction 1, $\chi^2$ was calculated using 23.5, the sum of BA for days one and two, and 29, the number of occurrences of BA during the fifth day as the observed frequencies of BA. The table was filled out with 176.5 and 71, the number of non-BA occurrences during the two test periods. The obtained $\chi^2$ value, corrected for continuity was 12.57. Since this value exceeds $\chi^2 .95$ with one degree of freedom, the test hypothesis may be rejected in favor of the one-sided alternative: the rate of BA during the fifth day is greater than the rate of BA during the first two days.

The $\chi^2$ test for prediction 2 was calculated in the same manner, taking 29 and 18.5 as the observed frequencies of BA, and 71 and 81.5 as the observed frequencies of non-BA. The obtained $\chi^2$ value is 2.49. This value with one degree of freedom approaches but does not exceed $\chi^2 .95$. The test hypothesis may not be rejected.

In this experiment the apparent change with respect to learning is statistically reliable. The change with respect to extinction, while it is in the predicted direction, is not statistically reliable. It should be noted that the periods chosen for the statistical test in advance of the experiment do not coincide with the periods of maximum experimental effect. There is a decline in the rate of BA between days four and five and an increase between days six.
and seven. Had some other unbiased method for this test been selected in advance of the experiment statistical support for the hypotheses might have been stronger.

A test of the hypothesis that the observed changes in the rate of BA are the result of changes on individual response rates was carried out as in the first experiment.

The observed value of BA on the fifth day is 29 and the observed value of AB for that day is 3. The expected value in both cases is given by

\[ \frac{29 + 3}{2} = 16 \]

The resultant \( \chi^2 \) is 21.12 which with one degree of freedom exceeds \( \chi^2 \) at the five percent level. The hypothesis that the obtained difference is a function of changes in individual response rates is not supported.

When the BA record is looked at as a percentage of all two-person outcomes only, as in Table 6, the results are even more striking. The BA outcome shows a steady rise from 12% on the second day to 30% on the first learning day and to a peak of 64% on the fifth day. The totals of the other two-person outcomes steadily declined, almost without exception during the same period; until on the fifth day they were represented only as a small fraction of the trial outcomes.

In the extinction period there appears to be a sharp break in the distribution of BA from 64% to 28%. The other


### TABLE 6

**THE PERCENTAGES OF ALL TWO-PERSON TRIAL ENDINGS IN TRIALS WHERE THERE WAS A CONVERSATION DURING THE SECOND REPLICATION**

<table>
<thead>
<tr>
<th>Day</th>
<th>AB</th>
<th>AC</th>
<th>BA*</th>
<th>BC</th>
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</tbody>
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**Operant Period**

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</thead>
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<td>7</td>
<td>35</td>
<td>14</td>
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<td>25</td>
<td>8</td>
<td>100%</td>
<td>90.5</td>
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<td>2</td>
<td>8</td>
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<td>12</td>
<td>13</td>
<td>30</td>
<td>15</td>
<td>100%</td>
<td>89.5</td>
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**Conditioning Period**

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<th></th>
</tr>
</thead>
<tbody>
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<td>3</td>
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<td>17</td>
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<td>15</td>
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**Extinction Period**

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<td>4</td>
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<td>23</td>
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<td>28</td>
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<td>100%</td>
<td>77.5</td>
</tr>
</tbody>
</table>

* BA was the contingent response.*
outcomes are represented more strongly and in general the record of the final two days begins to take on the appearance of the first two days.
CHAPTER VI

CONCLUSIONS

The results of these three experiments establish that under certain conditions a particular kind of social response can be conditioned and extinguished. In constructing the theory, at every stage, a concerted effort was made to maximize those conditions that seemed likely to promote this end.

The disadvantage of this research strategy is that the minimum conditions for the conditioning of a social response cannot be inferred from this investigation. A possible line of future research would be to investigate these conditions. Two such questions have been raised already: What is the relationship between the relative frequency of A and B in the operant period and the social response? What is the relationship between motivation, in this case measured by the degree of belief in extra-sensory perception, and the social response?

Other questions that arise in this context are: Can a social response be conditioned at the beginning of a trial as well as the end? Can such a response be conditioned with less restriction on the activity of the subjects?

The generality of the phenomenon is severely limited by some of these unanswered questions as well as by the
size of the sample and by other complications introduced by the use of the extra-sensory perception task. Strictly speaking the relationship discovered between reinforcement and a social response cannot be generalized very much beyond the groups studied in this investigation. There is some evidence that the particular procedure used limits the test of the hypothesis to subjects who are not unfavorably disposed towards extra-sensory perception. With sufficient ingenuity a task might be devised that would permit of a test of the relationship on a larger population than this.

On the evidence of this experiment it may be said that there is a relationship between reinforcement and an instance of a social response such that the rate of the response increases when it is followed by reinforcement and decreases when it is permitted to occur in the absence of reinforcement. The parameters of this phenomenon and its generality are as yet unknown.

An issue raised by this research is the extent to which the subjects were aware of the conditioning process. At no time in the course of the twenty-three sessions did any subject verbalize the contingency between response and reinforcement. Not infrequently a subject would doubt that the extra-sensory perception contingency was real. This tended to happen most often in groups where the conditioning was unsuccessful or equivocal.
At times a subject offered a hypothesis regarding the response-reinforcement contingency which, although incorrect, had similar implications. For example, in the third experiment many of the reinforced trials were the result of B nominating a color and A agreeing. In the post-group interview A felt that B was at times a very good guesser and B felt herself to be endowed with special powers. Interestingly this hypothesis was offered not as an alternative to the extra-sensory perception contingency but as an explication of it.  

In pursueing this research beyond the present study two separate directions suggest themselves. On the one hand it is possible to go more intensively into the conditions of the experiment as it is now set up and investigate factors that are associated with the conditioning. Some of these possibilities have been discussed already. Along this same line it would be interesting to know something about the attitudes that might be correlated with the position assigned to the individuals in the conversational sequence. Is this assignment in some way equivalent to the assignment of roles in a group and what is the emergent pattern of attitudes and sociometric choices?

16. It may at first seem that what was really conditioned in this experiment was B as nominator. This is not the case since there is a difference between the rates of BA and BC on the fifth day, as shown in Table 5:  
BA = 29, BC = 3, $\chi^2 = 21.12$, $p < .05$. 


Another possible direction of investigation would be to attempt the conditioning of other kinds of social responses. In some sense the order of speakers in a conversation is an extrinsic or contentless response. The order of speakers appears to be rather incidental to the group's instrumental behavior and the way it organizes itself to carry out this behavior. Is it possible to formulate social roles and other instrumental social behavior as social responses; and in that form to bring them under experimental control?
CHAPTER VII

SUMMARY

A social response was defined as a discriminated operant which includes the behavior of more than one organism in a group and is at least partly under the control of stimuli produced by the group itself.

The purpose of this investigation was to examine the relationship between reinforcement and the rate of one kind of social response, namely the serial order of the speakers in a conversation. It was hypothesized that the laws of learning discovered in the study of the behavior of individual organisms would be sufficient to account for this aspect of group behavior, requiring no further theoretical assumptions. When the response was followed by a reinforcing stimulus it was expected to occur more often. And when, subsequently, the response was permitted to occur in the absence of reinforcement its rate was expected to decline.

The particular social response studied can be best described in the context of the experimental procedure.

A three-person group of strangers was seated around a circular table, in the center of which there was a circular array of six differently colored lights. Before each subject was placed a small control box on which were mounted six buttons corresponding in color and order to the central lights. A central light could be turned on only if
all three buttons of that color were pressed. The light remained on as long as all three of its buttons were held down.

The subjects were instructed that they were taking part in an extra-sensory perception experiment. It was their job to select a series of messages to send telepathically to a fourth person in another part of the building. The possible messages consisted of the six colors of the lights. They were told to talk it over until they could all agree which was the most "sendable" message at the moment. As soon as they agreed they were to stop talking immediately, turn on that light, keep it on and remain silent while waiting for one of two sounds, a tone or a buzzer, which were identified as correct and incorrect. The group made one hundred such guesses on each of seven successive days; a total of seven hundred trials.

During the first two days the tone, which was the "correct" signal, was sounded after one quarter of the trials selected in a random fashion. The buzzer was sounded after the remaining trials. A record was kept of the identity and order of the last two speakers before the silences in each trial.

There are six possible two-person trial endings in a three-person group. One of these, the AB outcome, was followed by the tone whenever it occurred during the next three days.
In the final two days the BC outcome received the tone, while all other outcomes were followed by the buzzer.

The social response that was studied experimentally was the two-person conversational sequence AB. The first two days were used to establish a baseline rate for the response in the absence of systematic reinforcement. The next three days were the conditioning period and the final two days were devoted to extinction of the response.

This procedure was carried out for three separate groups. In two of the groups there was a statistically significant difference between the rate of AB during the first two days and the fifth day. In one of these groups there was a statistically significant difference between the rate of AB during the fifth and seventh days, while for the other group the statistical test for extinction was not significant, although the difference was in the predicted direction and approached the critical region.

The third group showed no apparent change in the rate of the selected response during the conditioning period and so the decision was made to continue the conditioning schedule past the fifth day. In all, this group was under the conditioning schedule for seven days and did not show any large apparent changes in the rate of the selected response.

Although the instructions were written with the intention of producing at least a short conversation in every
trial, this did not always occur. Some trials consisted of only a single speech; the speaker suggesting a color and the others acquiescing silently. In a few cases there was no speaking at all, the decision being made by gestures or having been made through a pattern set up in an earlier trial. The number of trials in which conversations actually took place ranged from a low of 26 to a high of 90 during the twenty-three experimental sessions. The overall median number of trials that contained conversations was 66. The day to day fluctuations in the number of conversations did not follow any readily discernable pattern. It seemed to start at a high level in all of the groups and then decline during the conditioning period, with occasional high performances, sometimes higher than the initial level.

When these data are examined separately, that is when the number of trials with the ending AB are considered as a percentage of the trials where two or more persons spoke, the results appear more orderly and are more nearly a match with the hypothesized distribution.

In the first group the initial rate of AB was 11% which rose to a height of 34% during the second day of the conditioning period and fell off to 18% under the extinction schedule.

In the second group, for which no differences at all were detected in the formal statistical analysis, the selected response started at 17% and rose steadily to 29% on
the fifth day. Thereafter it declined steadily to a low of 14% on the eighth day, even though the extinction conditions were not applied.

The third group began with the selected response at 13%. It seemed to rise in large intervals to a high of 64% on the fifth day. Under extinction conditions, its rate fell sharply to a low of 24% on the final day.

Other topics covered in the discussion included the following:

1. It was postulated that the observed changes in the rate of the selected response might be the result of changes in individual response rates. This hypothesis was tested statistically and was not supported.

2. The differential performance of the three groups was discussed and several tentative hypotheses were proposed to account for these differences.

3. The question of the awareness of the subjects was discussed. At no time did a subject verbalize the contingency between response and reinforcement, although many ideas were expressed about it. In the group where little or no experimental effect was produced there was considerable scepticism about the announced purpose of the experiment. In one of the groups with an unambiguous experimental effect the subjects seemed to accept the announced purpose and to explicate it and embellish it in their speculations.
It was concluded that a social response had been brought under experimental control. A number of questions for further research were raised, both with regard to discovering some of the parameters of the present research and extending it to other social responses more intrinsic to the instrumental behavior of groups.
APPENDIX A

The Geography of the Experimental Room

The letters "A", "B", and "C" used in the text to identify speakers refer consistently in all three experiments to specific seat positions in the experimental room. This may be of interest since these seat positions were slightly asymmetrical. The relative positions of the subjects can be seen in a schematic map of the experimental room.

Diagram of Experimental Room
APPENDIX B

Observer Reliability

A record of these experiments was kept by two independent observers. The tables contained in the body of the dissertation were constructed by taking the daily averages of the two observers within each response category. The daily totals of the separate observers for the three experiments are reported below in Tables 1, 2, and 3, respectively.

A trial by trial comparison of the protocols revealed that the two observers were in agreement in 79% of the total trials. Daily agreement scores are given in Table 4.
### TABLE 1

The Daily Totals in all Response Categories of Two Independent Observers During the First Experiment

<table>
<thead>
<tr>
<th>Observer</th>
<th>AB</th>
<th>AC</th>
<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
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<th>B</th>
<th>C</th>
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</table>
TABLE 2

The Daily Totals in all Response Categories of Two Independent Observers During the First Replication

<p>| Ob- | No | No Other- | Total |
|serv-| 1c | ord | er |</p>
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* Only one record was kept during this day.
### TABLE 3

The Daily Totals in all Response Categories of Two Independent Observers During the Second Replication

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<th>BA</th>
<th>BC</th>
<th>CA</th>
<th>CB</th>
<th>A</th>
<th>B</th>
<th>C</th>
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**TABLE 4**

The Number of Times within Each Block of 100 Trials That Two Observers Recorded Identical Responses*

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* Assuming that the twelve response categories represent twelve equiprobable events, two observers marking their records at random would be expected to record identical responses once in 144 trials.

** Only one record was kept during this day.
REFERENCES


ABSTRACT

THE OPERANT CONDITIONING OF
A SOCIAL RESPONSE

A social response was defined as a discriminated operant which includes the behavior of more than one organism in a group and is at least partly under the control of stimuli produced by the group itself.

The purpose of the study was to examine the relationship between reinforcement and the rate of one kind of social response, namely the serial order of the speakers in a conversation. It was assumed that the laws of learning discovered in the study of the behavior of individual organisms would be sufficient to account for this aspect of group behavior, requiring no further theoretical assumptions. When the response was followed by a reinforcing
stimulus it was expected to occur more often. When, sub-
sequently, the response was permitted to occur in the ab-
sence of reinforcement its rate was expected to decline.

**Method.** Subjects were asked to come to a series of
unanimous decisions about which of several stimuli to try
to communicate telepathically to a receiver in another room.
After each consensus they were to stop talking immediately,
concentrate on that stimulus, and wait silently to be in-
formed whether or not their message was received. After a
three-second delay they were signalled whether or not
their message had been received correctly and went on to
try again.

Each consensus constituted a trial, of which there
were 700 in all during seven days. A record was kept of
the identity and order of the last two subjects to speak
in each trial. In a three-person group there are six pos-
sible two-person trial endings. One of these endings (AB)
was the social response studied.

On the first two days the "correct" signal (positive
reinforcing stimulus) was sounded after one quarter of the
trials on a random schedule, in order to establish a base-
line rate for AB.

Days three to five were the conditioning period, dur-
ing which AB was reinforced whenever it occurred.
During the final two days, AB was extinguished by withdrawing reinforcement from it.

**Results.** The experiment was carried out on three groups. In one group there was a significant increase in AB during the conditioning period and a significant decrease during extinction. Another group showed a significant conditioning effect and a non-significant extinction trend. Systematic changes did not occur in the third group. Hence, the extinction period was omitted and the conditioning period was extended for four additional days.

In all three groups there were a number of trials during which fewer than two subjects spoke. When these trials are omitted from the analysis and AB is considered as a percentage of the trials where two or more persons spoke, the results conform more closely to the hypothesized distribution. Conditioning appears to have occurred in all groups and extinction in two of the groups. The baseline percentage of AB in the groups that showed both a conditioning and an extinction effect was 11% and 13%. During the final day of the conditioning period the rates were 33% and 64%, respectively. On the last day of the extinction period the respective rates were 18% and 24%. In the third group AB began at 17% and rose steadily to 29% on the fifth day, whereupon it declined to 15% on the ninth day, even though it continued to be reinforced.
An alternative explanation for the obtained behavior changes in terms of changes in individual response rates was evaluated and was not supported. The differential performance of the groups was discussed, as was the question of the subjects' awareness of the response-reinforcement contingency.

It was concluded that the social response studied had been brought under experimental control.
I was born in Detroit, Michigan, on January 19, 1935, the son of Samuel and Anne Levin, and attended public school there, graduating from Central High School in 1952.

From 1952 until 1957 I studied at the University of Michigan at Ann Arbor, majoring in philosophy as an undergraduate and in a year of graduate study. I received the A.B. degree in 1956.

After my marriage to Dori Appel in 1957 I came to Boston University, where I received the Master of Arts degree in psychology the following year. During these years I worked as a U. S. Public Health Service clinical psychology trainee at Boston State Hospital, Massachusetts Mental Health Center, Massachusetts Memorial Hospital, and the Judge Baker Guidance Center.