A PREFERENCE EXPERIMENT

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Summary

A preference experiment is described, and a sample experiment of the type is reported.

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1. Introduction:

The experiment reported in this paper was conducted in order to gain some experience in the organization, administration, and analysis of others of its general type. The type has been selected in an effort to find one that permits testing of a wide variety of mathematical theories pertinent to the study of social organizations. The one trial reported here is used only for convenience, as an example, in this very preliminary discussion of the planned experimental series.

2. The Type Experiment:

A group of individuals is asked to select one from a set of alternatives. The experiment is arranged so that each individual has a strong incentive to guide the group selection toward the alternative that he prefers. The group is encouraged to discuss the problem. The first member of the group to announce a selection commits the group by his act.

A variety of special restrictions may be placed on a single trial. A time limit is usually set on the length of time allowed for the selection, with the condition that failure to decide in time will result in a penalty being imposed upon each member. The pattern of communication between members may be restricted. The group will sometimes be given suggestions or instructions concerning the decision process it may use.

A series of trials will be made, in some instances, in which some subjects will repeat. Such a series enables the experimenter to condition his subjects. It also provides information concerning the dynamics of the group process. "Stooges" may be used to give the experimenter stronger control over the subjects. Drugs, hypnosis, and surgery could eventually be employed for similar purposes. It may be instructive to make some trials with rats, or pigeons, as well as with normal and abnormal human subjects.

Information concerning the subjects will be collected before and after each trial. This will include psychological and biological data, expressed preferences concerning the alternatives, the results of previous trials with each subject, and any other data that might help to explain the actions of the group.

3. The Problem:

The main problem is to develop a theory adequate for the prediction of the group selection in any single trial, in terms of data available prior to the trial. The theory may be denoted: $P_i(x,y)$ = the probability that the group will select alternative i if the prior data is x and the conditions of the experiment are y.

A secondary problem is to develop a theory that will predict interesting features of group activity encountered in the choice process. Under what conditions are coalitions formed? When is the decision rule based on unanimity, majority voting, or minority control? When is the decision process based on

Robert's Rules of Order, or on an organizational hierarchy, or on stochastic interaction as described by Bales? There are a number of mathematical and non-mathematical theories of the group process that can be tested by an appropriate form of the type experiment.

4. A Sample Experiment*

The subjects were three Harvard undergraduates:** S_1, S_2, S_3. The alternatives were ownership of one of eight physical objects:** θ_0, θ_1, θ_2, $\cdots$, θ_7.

The S_i were first asked*** to indicate their preferences within each pair (θ_i, θ_j) of ten objects consisting of the eight θ_i and, in addition, θ_8 = \$3.50, θ_9 = \$5.00 (Ba). The 45 pairs were presented to them in a random order, obtained by using a table of random numbers. This process was repeated (Be) at the end of the experiment, using the reverse order. The results are given in Table 1, following.

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* I am indebted to Professor Bales, of Harvard University, who provided the subjects and laboratory facilities for this experiment. Professors Bales, Mosteller, and Stouffer, all of Harvard's Laboratory of Social Relations, made many valuable suggestions concerning the design and conduct of this type of experiment—for which I am grateful.

** A brief description of subjects and objects is given in Appendix A.

*** The instructions, as read to the subjects, are given in Appendix B. Reference here to the steps in Appendix B will be made as Ba, Bb, etc.

Table 1

PAIRWISE PREFERENCES

Start			End			Majority	
S_1	S_2	S_3	S_1	S_2	S_3	Start	End
0 5 5 6 4 3	0 5 5 6 4 3	0 5 5 6 4 3	3 6 4 3 0 1	3 6 4 3 0 1	3 6 4 3 0 1	0 5 5 6 4 3	3 6 4 3 0 1
4 6 3 2 9 4	4 6 3 2 9 4	4 6 3 2 9 4	2 1 0 9 1 6	2 1 0 9 1 6	2 1 0 9 1 6	4 6 3 2 9 4	2 1 0 9 1 6
7 3 1 3 8 5	7 3 1 3 8 5	7 3 [redacted]	9 3 7 5 0 4	9 3 7 5 0 4	9 3 7 5 0 4	7 3 1 3 8 5	9 3 7 5 0 4
1 5 2 6 3 5	1 5 2 6 3 5	[redacted]	0 6 8 4 6 8	0 6 8 4 6 8	0 6 8 4 6 8	1 5 2 6 3 5	0 6 8 4 6 8
7 1 7 9 0 8	7 1 7 9 0 8	7 1 7 9 0 8	0 2 9 1 7 4	0 2 9 1 7 4	0 2 9 1 7 4	7 1 7 9 0 8	0 2 9 1 7 4
2 8 8 3 0 3	2 8 8 3 0 3	2 8 8 3 0 3	9 8 2 7 7 6	9 8 2 7 7 6	9 8 2 7 7 6	2 8 8 3 0 3	9 8 2 7 7 6
6 9 2 4 2 5	6 9 2 4 2 5	6 9 2 4 2 5	9 5 2 9 8 7	9 5 2 9 8 7	9 5 2 9 8 7	6 9 2 4 2 5	9 5 2 9 8 7
8 1 0 7 4 1	8 1 0 7 4 1	8 1 0 7 4 1	4 1 0 7 8 1	4 1 0 7 8 1	4 1 0 7 8 1	8 1 0 7 4 1	4 1 0 7 8 1
8 7 2 9 9 5	8 7 2 9 9 5	8 7 2 9 9 5	2 5 2 4 6 9	2 5 2 4 6 9	2 5 2 4 6 9	8 7 2 9 9 5	2 5 2 4 6 9
7 6 2 7 9 8	7 6 2 7 9 8	7 6 2 7 9 8	0 3 8 3 2 8	0 3 8 3 2 8	0 3 8 3 2 8	7 6 2 7 9 8	0 3 8 3 2 8
7 4 9 1 0 2	7 4 9 1 0 2	7 4 9 1 6 2	0 8 7 9 7 1	0 8 7 9 7 1	0 8 7 9 7 1	7 4 9 1 0 2	0 8 7 9 7 1
6 8 8 4 0 6	6 8 8 4 0 6	6 8 8 4 0 6	3 5 2 6 1 5	3 5 2 6 1 5	3 5 2 6 1 5	6 8 8 4 0 6	3 5 2 6 1 5
0 4 7 5 9 3	0 4 7 5 9 3	0 4 7 5 9 3	8 5 1 3 3 7	8 5 1 3 3 7	8 5 1 3 3 7	0 4 7 5 [redacted]	8 5 1 3 3 7
[redacted]							
3 6	3 6	3 6	0 5	0 5	0 5	3 6	0 5

The S_i were then examined individually (Bb). Interviewers obtained answers to the following questions:

Name? Age? College address? Home address? Class?
Previous School? Public or private?
Extracurricular interests? Grade group?
Father's occupation? What specifically does he do? His income?
Religious affiliation? If none, that of your parents?
Know either of the other subjects? Whom, and how well?
Veteran? Aspirations?

The data of Table 1 were examined to determine whether any object seemed to be unanimously preferred over all the others. None was, but it seemed wise to remove O_8 and O_9 in order to insure discussion of the non-monetary O_j competing for preference. Actually, the S_i were in rather good agreement about their preferences, and so it was not possible to establish a keen competition by any selection of a subset of the ten items.

The S_i were then asked to work as a group and select one from among the eight objects: O_0, O_1, $\cdots$, O_7 (Bc). A few questions were asked by the S_i pointed toward clarification of the rules of the experiment. One interesting exchange went roughly as follows:

S_2: "We are to indicate our selection by writing a number on the blackboard?"

E: "Yes."

S_2: "What if more than one number is written?"

E: "The first one written will be taken as your decision."

S_4: "Does that mean we are to agree on the choice?"

E: "No comment."

S_3: "Who will be here to break up the fight?"

E: "No comment."

S_1: Laughter.

In other words, the S_1 learned from this exchange that they would have to find their own decision process and that argument and force were both legitimate.

The group was able to make its selection rather easily in about ten minutes. Item θ_6 was chosen when S_3 wrote "6" on the blackboard. The argument was almost entirely between S_1 and S_3, and concerned θ_6 vs θ_1. An obvious general agreement was reached rather quickly that only θ_6 and θ_1 were of interest, with S_3 taking a vigorous lead in favor of θ_6, and S_1 opposing him in favor of θ_1. S_2 said little during this argument, but he did seem to settle it by a nod of the head in favor of θ_6, after S_3 and S_1 seemed to be hopelessly at odds. Snatches from this conversation are given in Appendix C.

After θ_6 was selected, it was removed and the experiment was repeated with the remaining seven objects: θ_0, θ_1, θ_2, θ_3, θ_4, θ_5, θ_7. The argument again was between S_1 and S_3, with S_1 taking a vigorous lead in favor of θ_1, S_3 opposing him weakly in favor of θ_2, and S_2 appearing to settle the matter by a nod after the deadlock. The object selected was θ_1, in about five minutes, and again it was S_3 who wrote the number on the blackboard. There seemed to be some carryover to the second choice from the argument during the first choice; for example, it may have been true that S_3 weakened his opposition to S_1 because

of a feeling that this was only fair, since he had won his goal earlier in opposition to S_1. This dynamic effect over time would be an especially interesting one to study systematically in this type of experiment.

The group was observed (Bd) through a one-way window during the experiment. Concealed microphones were used to make a sound recording of all that was said. Professor Bales and his associates recorded group interaction categories during the discussion in the manner that he employs commonly* in his studies of the interaction process of a small group acting in a problem-solving situation.

Professor Bales also made a separate interaction process analysis, of the same three subjects, using his standard techniques immediately following the preference experiment. It had been our hope that each preference experiment would take more than thirty minutes so that he might have an adequate quantity of interaction data to permit a comparison of results in the preference situation with those he obtains in other problem-solving situations. Interaction data, whether they are obtained during the preference experiment or separately, will be used in the future as part of the information (concerning the subjects) employed to predict and explain the observed preference and the decision process.

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*Robert F. Bales, Interaction Process Analysis, Cambridge (1950), Addison-Wesley Press.

5. Analysis of Sample Experiment:

The Sample Experiment was run primarily to test certain aspects of the problem of administering such a type of trial.* From this standpoint, it seems clear now that the initial pairwise preference data should be obtained for several more subjects and alternatives than are to be used in the group trials. It should be possible then to select subsets of subjects and alternatives which will lead to difficult decisions because of wide disagreement among the preference relations. The other features of test administration seemed to be quite satisfactory, although some real information was lost by not recording certain unspoken expressions.

The real values that should be attached to the alternatives to measure their preference disparities are probably not measured well by the dollar-value to the individual concerned. For example, S_3 (whose aspiration is Fine Arts) became quite ego-involved in his attempts to convince S_1 and S_2 that the Art Book was wonderful and the Hassock was a sickly liver-green unfit for anybody's apartment. Again, S_1 became quite aggressive when S_3 spoke with some contempt of all in the Government Civil Service, while in ignorance of the fact that the father of S_1 is so employed. Indeed, there was no dollar-value attached to the alternative selected in the subsequent interaction process experiment and yet the subjects debated the issues with sincerity, enthusiasm, and feeling. Even when

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*A preliminary draft of a manual for this type of experiment may be found in Appendix D.

dollar-value of the alternatives is a dominant factor, the significance in the experiment will depend upok the subjects and their financial status, since a wealthy subject may stand for his preference much less strongly than will a less wealthy subject to whom the dollar-differences are more important.

The preference relations, before and after the group discussions, are displayed in Table 2, following, in a form somewhat different from that used in Table 1 for the same basic data.

Table 2

Legend:
x = Start
○ = End

PAIRWISE PREFERENCES

For S_1:	0	1	2	3	4	5	6	7	8	9
0	⊗			○	⊗	⊗		⊗		
1	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
2	⊗	x	⊗	○	⊗	⊗	x	⊗		
3	x		x	⊗	⊗	x		⊗		
4					⊗					
5				○	⊗	⊗		⊗		
6	⊗		○	⊗	⊗	⊗	⊗	⊗	○	
7					⊗			⊗		
8	⊗		⊗	⊗	⊗	⊗	x	⊗	⊗	
9	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
Total x	7	2	5	5	10	8	5	9	3	1
Total ○	6	2	5	8	10	7	3	9	4	1

For S_3:	0	1	2	3	4	5	6	7	8	9
0	⊗	⊗	⊗	⊗	⊗	⊗		⊗		
1		⊗		x	○	○				
2		⊗	⊗	⊗	⊗	⊗		x		
3		○		⊗	○	⊗				
4		x		x	⊗					
5		x			⊗	⊗				
6	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
7		⊗	○	⊗	⊗	⊗		⊗		
8	⊗	⊗	⊗	⊗	⊗	⊗		⊗	⊗	
9	⊗	⊗	⊗	⊗	⊗	⊗		⊗	⊗	⊗
Total x	4	9	5	9	8	8	1	6	3	2
Total ○	4	8	6	7	10	9	1	5	3	2

For S_2:	0	1	2	3	4	5	6	7	8	9
0	⊗		○	⊗	⊗	⊗		⊗		
1	⊗	⊗	○	⊗	⊗	x		⊗	⊗	
2	x	x	⊗	⊗	⊗	⊗	x	⊗		
3				⊗	⊗	○		⊗		
4					⊗					
5		○		x	⊗	⊗		⊗		
6	⊗	⊗	○	⊗	⊗	⊗	⊗	⊗	○	
7					⊗			⊗		
8	⊗		⊗	⊗	⊗	⊗		⊗	⊗	
9	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
Total x	6	4	3	8	10	7	4	9	3	1
Total ○	5	4	6	7	10	7	2	9	4	1

For S_4:	0	1	2	3	4	5	6	7	8	9
0	⊗		○	⊗	⊗	⊗		⊗		
1	⊗	⊗	○	⊗	⊗	⊗		⊗	⊗	
2	x	x	⊗	⊗	⊗	⊗	x	⊗		
3				⊗	⊗	⊗		⊗		
4					⊗					
5					⊗	⊗		⊗		
6	⊗	⊗	○	⊗	⊗	⊗	⊗	⊗	○	
7					⊗			⊗		
8	⊗		⊗	⊗	⊗	⊗	x	⊗	⊗	
9	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
Total x	6	4	3	7	10	8	4	9	3	1
Total ○	5	3	6	7	10	8	2	9	4	1

An "x" in the i^{th} row and j^{th} column ($i \neq j$), of the matrix for S_k, indicates that S_k preferred O_i to O_j at the start; similarly, an "○" indicates preference at the end. A count of the marks in each column indicates the rank of the item, and the ordering is transitive if and only if the column totals are distinct.* For example, from Table 2, it is seen that S_1 had the following transitive preference order at the end of the experiment: $O_9\ O_1\ O_6\ O_8\ O_2\ O_0\ O_5\ O_3\ O_7\ O_4$. Transitivity means, of course, that the objects can be listed so that each is preferred to all that follow it, as for the list just given for S_1. Intransitivity means that there is at least one cycle; for S_1 at the start of the experiment this was: O_2 preferred to O_5 preferred to O_3 preferred to O_2. The preferences may be written in the following alternative form:

Table 3

PAIRWISE PREFERENCES

Start	S_1:	9	1	8	(2	6	3)	0	5	7	4
	S_2:	9	(8	2	6	1)	0	5	3	7	4
	S_3:	6	9	8	0	2	7	(5	4	1	3)
	S_1:	9	(8	2	6	1)	0	3	5	7	4
End	S_1:	9	1	6	8	2	0	5	3	7	4
	S_2:	9	6	(1	8	0	2	3	5)	7	4
	S_3:	6	9	8	0	7	2	3	1	5	4
	S_1:	9	6	1	8	0	2	3	5	7	4

* This theorem is very easily proved and probably can be found somewhere in the scientific literature. A thorough discussion of preference relation structure may be found in the recent monograph: Kenneth J. Arrow, Social Choice and Individual Values, Monograph No. 12 of the Cowles Commission for Research in Economics (1951) John Wiley and Sons, Inc. (Also RAND Research Memorandum, RM-291)

The parentheses denote instances of intransitivity and signify that the item at the end of the set enclosed in a pair is preferred to the one at the start of the set; for example, S_2 preferred O_5 to O_1 at the end of the experiment, but was transitive otherwise as shown in Table 3.

Let us consider the result of the first trial, in terms of the pertinent preference data from Table 3; for this purpose objects O_8 and O_9 must be deleted. The decision process started with an attempt to get unanimous agreement on some one item; this failed because S_2 and S_3 wanted O_6, whereas S_1 wanted O_1. The next step was an effort to establish facts and opinions concerning the values, and S_3 succeeded in his campaign favoring O_6 — as can be seen by comparing the orderings at start and end, since both S_1 and S_2 moved O_6 ahead of O_8. The third step was a recognition of the majority favoring O_6 and a quick decision on it.

The second trial, considered in terms of the data of Table 3 with O_8, O_9, and O_6 omitted, involved essentially the same three steps as for the first trial. This time S_1 and S_2 formed a majority favoring O_1 over S_3, who favored O_0. There was a noticeable tendency for S_3 to withdraw in the second trial, on the basis that he had already obtained his main objective; so the others should have their choice next.

6. Another Sample Experiment:

The subjects were the author and two of his friends: S_1, S_2, S_3. The alternatives were eating one of eight meat courses

at dinner: O_1, O_2, $\cdots$, O_8. This was a very informal experiment, no records were kept, and it is reported here in order to illustrate an interesting preference situation. The author was guest of the other two subjects, who are man and wife, and the experiment was done in a spirit of fun.

There were four steps: First, an attempt at unanimity that failed. Second, an attempt to find a majority in favor of the favorite meat course of one of us; which also failed. Third, an attempt by the couple, which almost succeeded, to form a coalition with a non-monetary side-payment from husband to wife so that she would side with him in favor of his first choice. Fourth, a successful attempt to agree unanimously on a choice not the first one for any of us. I have inferred, from the discussion, that the probable preference orderings for the three of us were as shown in Table 4, following, where I have omitted the four meat courses that seemed to have no effect on the problem.

Table 4

PAIRWISE PREFERENCES

S_1:	Crab, Veal Cutlet, Swordfish, Steak
S_2:	Steak, Veal Cutlet, Crab, Swordfish
S_3:	Swordfish, Veal Cutlet, Steak, Crab
S_4:	Veal Cutlet, (Swordfish, Steak, Crab)

So we all ate veal cutlet, and liked it!

The discussion was quite interesting and delayed us in placing our order by at least twenty minutes. The attempt to form a coalition, and the argument generally, were certainly less vigorous than should be expected under even slightly less friendly circumstances. And if the other courses were included in the experiment, more than the number of alternatives would rise—especially so if I might somehow be forced to eat spinach.

7. Summary:

Three trials of a type experiment were run. In each trial, three subjects worked as a group in the selection of one object, from among several, knowing that each was to receive a duplicate of the one chosen. The decision process seemed to consist of: first, an attempt at unanimity; second, an interchange of information and influence; third, an attempt at a majority decision on the favorite object for some one subject; and fourth, an attempt at a unanimous decision on some object not favored by any one subject. The pairwise preferences expressed by the subjects were consistent with the results and indicate that more difficulty may be met in the decision processes, in this type of experiment, when the group preference order under majority voting is a cycle.

APPENDIX A

SUBJECTS AND OBJECTS

1. Subjects:

The three subjects were Harvard seniors, who were employed at the rate of $1.00 per hour. They were essentially unacquainted with each other prior to the experiment. Although none of them had had much experience as an experimental subject, they were all a bit on the skeptical side and, for example, were quite prepared to find that gifts promised to them by the experimenter would not actually be forthcoming.

Question	S_1	S_2	S_3
Age	23	20	23
Secondary School	Public	Public	Private
Marital Status	Married	Single	Single
Extracurricular	Track	Music	German Club
Grade Group	V	IV	III
Parents' Income	$3,600	$7,300	Self-supporting*
Father's Occupation	Bldg. Insp.	C. P. A.	Engineer
Religious Affiliation	Protestant	Jewish	Catholic
Veteran	Yes	No	Yes
Career	Electronics	Geography	Fine Arts

* Parents separated. S_3 was in mother's care from age 14.

2. Objects:

The eight objects were selected so as to have varying appeal to the subjects.

	Object	Price	Remarks
O_0	$2.00	$2.00	
O_1	Hassock	$4.95	Green plastic
O_2	Travel Book	$3.95	Lowell Thomas on Tibet
O_3	Bag	$3.50	Canvas utility
O_4	Perfume	$5.40	Domestic make
O_5	Pen	$3.95	Waterman
O_6	Art Book	$3.95	Art and life in America
O_7	Percolator	$4.45	Aluminum

The prices listed are those at the Harvard "Coop" and include taxes. The Art Book recently had been marked down from $7.50 to $3.95.

APPENDIX B

INSTRUCTIONS FOR PREFERENCE GROUP

(a) You are being asked to participate in an experiment in human relations.

First, you will be asked to indicate, in writing, your preferences between pairs of objects that will be shown to you. You will note that each object is identified by a single digit. You are not to carry on any discussions whatsoever among yourselves until later on in the experiment when we will ask you to do so.

We will indicate a pair of objects by writing a two-digit number on the blackboard, each digit corresponding to one of the objects as numbered where you can see plainly. You are to inspect the two objects, write down the two-digit number, and circle the digit corresponding to the object you should prefer to have as a gift from us—if you are quite indifferent, please indicate a choice anyhow.

(b) Now you will be asked to provide certain background information concerning your personal history.

(c) You are now to work as a group and are free to talk to each other. You are asked to choose one from among the eight objects on the table and to indicate your choice by writing the corresponding digit on the blackboard. Each of you will be given a duplicate of the object chosen for his permanent possession as a gift from us. Each of you will, of course, also receive the regular payment for time worked. You will be allowed

at least thirty minutes to make your choice, and at most a number of minutes now known to us but not to you, but in any case not more than one hour. If you should fail to show a choice on the blackboard by the end of the allotted time, then none of you will receive a gift object.

I will be glad to hear any questions you may have now concerning the experiment, of which I shall answer certain ones and refuse to answer certain others by saying "No comment." The time for the experiment will start after this question period. Are there any questions?

(d) This room is equipped for observation and the conversations will be recorded. I will retire to the observation room now and you may go ahead with the experiment.

(e) We will now re-do the pairwise preference forms.

APPENDIX C

CONVERSATION SNATCHES*

1. First Preference Trial.

S_2: We're only going to get one thing; we can only put one number on the board.

S_3: No, he's going to copy it; he said something about things in triplicate, one of those things.

S_2: Is that the way you understand it?

S_1: That's the way I understand it.

S_2: We're all going to get the same things.

S_1: That's why we have to jointly decide. Now which of these things would you take?

S_2: Why don't we do it by process of elimination?

S_3: . . . . . .

S_2: All right. Well, the coffee pot is out.

S_1: . . . but I'm just in the process of equipping an apartment.

S_3: Oh, I see. Well, you certainly couldn't use any perfume, could you?

S_1: No. Well, the perfume and the coffee pot's out.

S_3: And the pen is cheap.

S_2: So the pen's out.

S_3: The book's no good. (Referring to travel book)

S_1: I don't think the bag is bad. Let's take a look.

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* The record was difficult to transcribe; consequently, the report here is not completely accurate.

S_3: The bag's no good.

S_2: I have a good bag, and this bag is very cheap and flimsy.

S_3: The book is just no go. And that hassock!

S_1: Well, that would go very well in the apartment, but I don't think it's worth very much.

S_3: No, it looks cheap. See the stitching on the side.

S_2: What do you think of the color?

S_1: I think it would go very well.

S_2: It's a nauseous color. However, it would fit in with my room, too.

?: [illegible]

S_1: Well, after all, you don't want to eat it.

S_3: Put your feet on it?

S_2: It looks like a refugee from the wrong end of the kitchen.

?: [illegible]

S_1: What's this odd. . . ?

S_3: Oh, that's a wonderful book. There are illustrations there that give credit for the Calloran collection that . . . . It's quite obviously the best thing in the room. . . . . If you want to look at it quite monetarily, it's worth more than $2.00, and we have eliminated everything but that 50-cent pen.

S_2: No, we haven't eliminated the hassock. There's two people here. . . .

S_3: Two people may be here, but I don't want that hassock.

S_1: Suppose we only got one of these. What would we do with it?

S_2: Oh, we can draw straws for it.

S_3: That's a wonderful book. It covers a great period in American Art.

S_1: You make me laugh. (Laughter)

S_3: Well, I'm taking a fine arts course and it starts in the beginning and comes right up to date. If you are interested in art, it's a nice thing to have around.

S_1: Are you interested in art?

S_2: Well, I've got enough of those survey books to last. . . . I don't know enough about that one to dispute it.

S_1: Well, that comes between the. . .another book.

S_3: You mean to tell me that you're rejecting that for that hideous hassock!

S_1: Right-O!

S_1: You know what talked me out of the hassock?

S_3: It just sits there like an evil toad.

S_1: I wonder if we're getting this same color?

S_3: He said identical.

S_1: I thought he said duplicate.

S_3: Well, duplicate. He infers that it will be exactly the same.

S_1: Well, as a matter of fact, that wouldn't go too well with pink wallpaper, would it?

S_3: No.

S_2: No, it wouldn't.

S_1: Then we're left by process of elimination with this book.

S_3: Yep.

S_2: Yes.

S_1: We don't want the two bucks—it's worth more than that. So it's the book.

?: . . . . . .

S_3: Oh, we have to put the number on the board.

S_1: Oh, yeah, that is right. Wait a minute; what number is it? I've forgotten.

S_3: 6.

S_1: Oh, yes.

S_3: Do we have to stay here until 4:30?

S_1: Look, sure now we don't want anything else?

S_3: Oh, positively.

S_2: That's what they're waiting for us to do. They're beginning to. . . .

S_3: The organization begins to squabble.

S_1: Does anybody know anything about perfume—I don't.

S_2: Yes, that's cheap perfume. . . . . That's drug-store perfume. You don't want anything to do with that.

S_1: Elizabeth Arden, I think, or something like that.

S_3: Oh, this isn't perfume. It doesn't say whether it's perfume or cologne.

S_1: It couldn't be worth very much.

S_2: OK, then, the book has had it now.

* * *

2. Second Preference Trial.

S_2: I don't know what you need, but the money looks good to me right now.

S_1: I think the hassock is worth more than two bucks.

S_3: You have an apartment. I'll give in to anything—I've got the art book now.

S_1: I will admit that color is not too attractive.

S_2: It's rather repulsive.

S_1: But if it were just some other color, I think I could possibly do with it. Maybe my wife could cover it or something. Of course, in the rooms up there, you don't have to. . . .

S_3: You can paint it.

S_2: It's very well constructed.

S_1: It's that . . .material that you can put anything on. It's a plastic.

S_3: Well, that's it.

S_1: What's this book?

S_3: Oh, he's such a. . .person.

S_1: Well, I've read it.

S_2: The thing is, I'm opposed to buying almost any book that you can get in the library except something you're going to want.

S_1: This isn't one of those—I think it costs more than $2.

S_2: This book?

S_3: You can get it for 75 cents in any of the stores along here.

S_2: I doubt it.

S_1: They took all the prices off all the books, you notice. Dirty trick. They cut the corners off with the price on, so you can't tell, naturally.

S_3: I know about the art book because it's courtesy of Calloran collection, which is in the Boston Museum of Fine Arts and is comparatively new.

S_1: How much would that art book be?

S_3: I don't know—anywhere between $5 and $7; maybe even more. . . . . Open that brown bag. Maybe there's some valuable treasure in it.

S_1: Say, that's a good idea. It's probably got a penny in the botton, or a ten-dollar bill. That would be a dirty trick to pull that on someone. Look in the coffee pot. Can't be too careful.

S_1: I will probably go home and my wife will tell me Blue Grass is a very valuable perfume.

S_2: No, it's not. I know it isn't.

?: . . . . . .

S_1: You're sure about that pen, now. That pen fooled me before when we wrote down preferences of objects.

S_3: Isn't that pen a Waterman's? It sells for $2 and never breaks. The only thing that breaks is the. . . .

S_1: Yes, it's a Waterman, but that doesn't mean much.

S_2: They could label it Ralingos or Maine and Townsend.

S_2: This plastic is no good. It's not the best.

S_1: We are collecting Revere Ware.

S_3: Is that Revere Ware? Is that Wearever?

S_1: It's about the best aluminum ware. My wife probably doesn't want to make coffee in this, anyway. She probably wants a Silex.

S_3: You would need quite a large family for that.

S_1: How about the hassock—you can always paint it or dye it.

S_3: Yeah.

S_2: It's rather well constructed. . . . . I'm not going to argue the color.

S_1: My wife...my friends might think I bought it. . . . . I can tell her I won it in a crap game. . . . . They're never going to believe it anyway—how I stumbled on this job.

S_3: $1.50 plus an art.book. The afternoon is complete.

. . . .

S_2: I agree on the hassock.

S_1: Yes.

S_3: Yes.

* * *

3. Standard Interaction Trial.

S_3: What do we think of Miss Benson?

S_2: Now, wait a minute. Let's do it this way—there are two things to be considered. One is what we should do immediately about the personnel involved. That is the immediate problem, and the other is the long-range one so that this should not happen again.

S_1: First, let's decide something. Did we all have the same material?

S_3: Well, let's not bother with that because how can we tell?

S_1: Well, we're all discussing the same case. I wonder if we all have the same materials?

S_2: This made me suspicious of that.

S_3: Yes, I'm sort of that way.

?: . . . . . .

S_2: There was this Miss Benson. We'll take it the way they put it. There was this Colonel Allen who was in charge of the War Department. Shortly after the beginning of hostilities he took off for a tour of the Far East. When he came back he found his particular office had mushroomed in his absence and that his secretary, who was an old employee, had had things running quite well. She was most experienced and also because she had the position of being secretary to the head of the department, she had a position of command. So, therefore, the new people who were coming in, as this Miss Benson, were being shepherded

by this Miss Reynolds, that is, Colonel Allen's secretary, and she was sort of making sure that they did the proper thing and that their behavior. . .of the department, etc.

This Miss Benson was from Minneapolis. She was of the classification that was one of the beginning grades of stenographer, which is. . . .

S_1: It sounds as though we had the same material.

S_2: Well, let's follow. . .in case the conclusions were different. She was in the stenographic pool and was sent to this office, Colonel Allen's office, after various assignments. The very first day she had a run and had to go downtown before work to get a new pair of nylons. She showed up 45 minutes late and she didn't explain because she had done so much overtime in other jobs that she didn't feel she owed anybody anything. She finally did very good work, but by this time Colonel Allen had come back. She made some error in the routing of his mail and this brought a rather. . .from him.

S_2: Now did that come before or after?

S_3: The late business?

S_1: No, the late business was first; the second was the routing of the Colonel's mail, and the third where she complained about the errands Miss Reynolds was sending her on.

S_3: The errands were the last thing.

S_1: Well, I think it's all along like you say—the immediate solution and the long-run solution.

S_3: The immediate solution to what?

S_2: Well, the immediate solution is what should you do with Miss Reynolds and what you should do with Miss Benson.

S_3: Well, that should be back in the pool.

S_2: Send her back and she should stay there.

S_1: And Miss Reynolds is working right along?

S_2: Well, the immediate solution is to leave Miss Benson in the pool. To bring her back would only antagonize her. So she stays where she is. We're sorry she's been shafted but she stays shafted.

S_2: We say we're sorry this happened and this is not put down as a black mark permanently against her.

S_1: But we should do something about the overtime.

S_3: But the problem of that office and the whole setup in general on that.

S_2: But remember we're an advisory committee to Colonel Allen, not to the bureau of civilian placement.

S_3: He should have a steady grip (?) on his office.

S_2: Well, he's doing it now he's back.

S_3: Well, you get no evidence of that at all. What happens is Miss Reynolds is still running the joint.

S_1: The trouble is it has expanded to such an extent that he is not able to run it alone now.

S_2: Well, let's say this then, that Miss Benson remains back in the pool; she's a closed issue. We won't worry about her any more except to point up altering her record so this is not held against her. So she's out of the

picture. This Miss Reynolds, she's a necessary evil. She's an old battle-ax—been there a long time. But also she knows the ropes and apparently does a good job. We're not told anything about that; so let us make the assumption.

S_1: How do you like this. It's obvious that someone has got to get these new people and indoctrinate them into the department and keep watch over them. How about someone other than Miss Reynolds. She's relieved of this responsibility because she has so much else to do.

S_3: Now, wait a minute. She has some problems, too, . . . in that office.

S_2: That's right. In that office there should be someone whose job it is to greet these people and tell them the ropes and give them a book which says this is how you excuse tardiness, this is how you take care of a leave of absence, etc., etc. There should also be a system of reprimands set up, like the Army has.

* * *

APPENDIX D

TENTATIVE MANUAL FOR A PREFERENCE EXPERIMENT

I. Problem:

M subjects (S) are together in a room and are shown N objects by the experimenter (E) with the request that they choose one of the objects, and with the promise that the group will be given the object chosen for permanent possession. The choice is made when one of M levers is first depressed in some manner by the group. The group is told that they will have a minimum of t_{min} minutes and a maximum of t_{max} minutes in which to make their choice, the actual time t allowed to be determined by the probability distribution f(t) known to E, but not to S; and if the choice is not made before t minutes have elapsed, then no object will be given to S. E will answer only those questions asked by S that do not pertain to the administration of the experiment; for example, as to the location of the washrooms or the meaning of the concept of probability distribution, but not as to the type of interaction or decision processes allowed or expected. The problem is to predict successfully the choice made in each trial by application of a single theory: $P(x/\theta)$ = the probability of choice x for characteristics θ of S, where θ represents any set of operationally meaningful parameters that are measured prior to a trial. (Something like a χ^2 test will provide the definition of the measure of success of the predictions.)

II. Materials

N objects, selected by E and available in quite exact duplicate, which should vary considerably in value to S but not much in market value. A few of the objects must be packages of money, in order that the S's preferences may be related crudely to monetary values for the eventual analysis of the data. Objects may be N framed photographs of widely varying appeal, N meals from a single menu, or N objects differing more widely in character (as for those in a young boy's pocket or a woman's purse). Each object is numbered plainly where it can be seen by all subjects. N for this experiment may be any number between 8 and 15.

Data Sheets*

Pairwise Comparison Form
Rank Order Form
Background Information Forms

Random Order Lists**

Sound Recording Apparatus

Blackboard

Pencils and Scratch Paper

III. Subjects:

M persons are selected by E who may be either very different in background characteristics or very similar. They may have had no previous experience as a group, or may come to a decision. An Army squad, or the Board of Directors of a

*See Exhibit 1 for sample.
**See Exhibit 2 for lists.

corporation are examples of the experienced group. M may be any number between 5 and 20.

IV. Procedure:

Main Steps:

a. Pairwise Comparisons

b. Rank Order

c. Background Data

d. Group Preference

e. Disposition of Object

f. Repeat A

g. Dismissal

a. Pairwise Comparisons: S's are seated in the experimental room and each S is given a Pairwise Comparison Form. The objects are placed where all S's can inspect them.

> E: "You are being asked to participate in an experiment in human relations.
>
> First, each of you will be asked to indicate in writing his preferences between pairs of objects that will be shown to you. You will note that each object is identified by a number. You are not to carry on any discussions whatsoever among yourselves until later on in the experiment when we will ask you to do so.
>
> I will indicate a pair of objects by writing two numbers on the blackboard, each number corresponding to one of the objects as you can see plainly. You are to inspect the two objects, write down the two numbers, and circle the number corresponding to the object you should prefer to have as a gift from us. If you are quite indifferent please indicate a choice anyhow. For example, if the first pair you are considering is 2 and 4, then write 2 in the first column and 4 in the second column, both on the first line; and if you prefer 2 to 4, then draw a circle around the 2. You will notice that this example appears

at the top of your form as a sample. Be careful not to let any others see your records."

E announces pairs of numbers from the Random Order List for the N used in the experiment, preferably on the blackboard, continuing until all the pairs have been read off from the List. E collects the Pairwise Comparison Forms from the S's when they are filled out.

b. Rank Order: Each S is given a Rank Order Form.

E: "Please list all the objects on the form in your order of preference. Use the identifying numbers as names for your entries. For example, if the object you like best is No. 3, then write a 3 on the first line in column 1. Next, on line 2, enter the number for the object you like second best. Continue until all objects are listed in column 1. Do not make erasures or other changes this first time through.

Now, if you are not satisfied with the ordering in column 1, you should repeat the process using column 2 and continue using a new column until you are satisfied with your preference ordering—except that you are limited to five columns.

Finally, you must indicate which column best reflects your preference. Do this by making a checkmark at the top of the preferred column."

E collects the Rank Order Forms from the S's and inspects them to be sure that they are in order. Any not found to be complete or legible are returned to the S's for corrections.

c. Background Data: Each S is given a Background Data Form.

E: "Please fill in all entries completely and legibly on your Background Information Form."

When done, E collects them, making sure that all entries are complete and legible. E also marks the date and experiment number on each form. While the S's are filling in the background data forms, E is making a quick analysis of the completed rank order forms in order to select a sub-set of objects and subjects that will provide the most interesting group choice experiment. Qualitatively, the task is to select sub-sets with the most widely varying rank orders in order that there be maximum disagreement between subjects in working to the group choice. Objects that find favor with a majority of the subjects should be removed from the experiment and at least three objects should remain that are about equally favored by three relatively equal subgroups. At present, this selection is a matter of judgment by E, although routine selection procedures will be developed for use in later experiments.

E dismisses any subjects who are not to be used in the group experiment and also sets aside objects that are not to be used.

d. Group Choice: E now picks a minimum time and a maximum time that, to the nearest five minutes, he estimates will almost surely bracket the length of time that would be used by the group to make the group choice if no time limit were set. E then selects a time between the minimum and the maximum, to the nearest five minutes, by a random device with each possibility having equal probability. For example, if the minimum time is 20 minutes and the maximum is 60 minutes, E would

select at random from among the numbers: 20, 25, 30,···, 55, 60.

> E: "You are now to work as a group and are free to talk to each other. You are asked to choose one from among the ? objects on the table and to indicate your choice by writing the corresponding number on the blackboard. The first number written on the blackboard will determine your choice.
>
> It is almost certain that one of you will receive the object chosen for his permanent possession at the conclusion of the experiment. Each of you will, of course, also receive the regular payment for time worked.
>
> You will be allowed at least ? minutes to make your choice, and at most a number of minutes now known to me but not to you, but in any case not more than ? minutes. If you should fail to show a choice on the blackboard by the end of the allotted time, then none of you will receive the gift object.
>
> I will be glad to hear any questions you may have now concerning the experiment. Of these I shall answer certain ones and refuse to answer certain others by saying "No comment." The time for the experiment will start after this question period. Are there any questions?
>
> This room is equipped for observation and the conversations will be recorded.
>
> I will retire to the observation room now and you may go ahead with the experiment."

E retires to the observation room and makes a sound recording of the group discussion. At the end of the time allowed by his random selection he terminates the group discussion, or sooner if the group has expressed its preference by writing a number on the blackboard. E should avoid any conversation with the subjects during the group experiment except as it may be essential to clarify obvious misunderstandings concerning the rules of the experiment.

If the group succeeds in selecting an object, then the next step in the experiment is to arrange for its disposition by further group discussion. If no choice is made, this step is omitted.

e. Disposition of Object:

> E: "Object ? now belongs to you as a group. You are asked to determine its disposition by discussion a among yourselves and you are free to work out any solution for your problem that you find attractive.
>
> The first person to pick up the object will own it.
>
> You will be allowed at least ? minutes to make your decision, and at most a number of minutes now known to me but not to you, but in any case not more than ? minutes. If none of you picks up the object before the end of the allowed time, then none of you will receive it.
>
> Are there any questions?
>
> I will retire to the observation room now and you may go ahead with the experiment."

E will pick the minimum, maximum, and actual time allowed in a procedure exactly analogous to that under D and will terminate this step of the experiment in similar fashion.

f. Repeat a: E now replaces the objects that were set aside and distributes Pairwise Comparison Forms to the subjects who participated in the group decisions.

> E: "We will now repeat the pairwise comparison step. Please write down each pair as before and circle your choice. Before writing your choices, please fill in the headings on top of the form."

E uses the same random order list and collects the complete forms when the S's have filled them out.

g. Dismissal:

E: "Thank you for your cooperation in this Experiment."

E then pays and dismisses the subjects.

EXHIBIT 1 — DATA SHEETS

(A)

PAIRWISE COMPARISON FORM

Name: _____

Sample

Column 1	Column 2
②	4

	Column 1	Column 2
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

	Column 1	Column 2
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		

EXHIBIT 1 — DATA SHEETS (Con't.)

(B)

RANK ORDER FORM

Name: _____

	Column 1	Column 2	Column 3	Column 4	Column 5
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

EXHIBIT 1 — DATA SHEETS (Con't.)

(C)

BACKGROUND DATA FORM

Name:

Age: Sex: Marital Status:

College Address:

Home Address:

Class in School:
Concentration:

Where did you go to school before you came here?
Public Private

What extracurricular interests if any do you have?

What grade group are you in?

Father's occupation? What specifically does he do?

Approximate income of father last year?

Religious affiliation:
If you have none, your parents?

Do you know either of the other subjects? If so, which, and how well?

Are you a veteran?

What do you hope to do when you finish school?

E X H I B I T 2

RANDOM ORDER LISTS

N = 2

1, 2

N = 3 (3)

1, 3
1, 2
2, 3

N = 4 (6)

2, 3
1, 4
3, 4
1, 3
2, 4
1, 2

N = 5 (10)

3, 5
2, 5
1, 3
1, 4
1, 2
1, 5
2, 4
2, 3
4, 5
3, 4

N = 6 (15)

5, 6
2, 6
2, 4
1, 6
1, 4
2, 3
4, 5
1, 5
3, 4
4, 6
3, 5
1, 2
1, 3
2, 5
3, 6

N = 7 (21)

1, 2
1, 6
1, 3
3, 5
2, 6
2, 3
1, 5
4, 5
1, 4
3, 6
5, 7
2, 5
4, 7
2, 7
5, 6
2, 4
1, 7
3, 4
6, 7
4, 6
3, 7

N = 8 (28)

3, 4
2, 7
3, 6
4, 7
3, 5
1, 8
6, 7
5, 8
2, 3
3, 8
2, 4
4, 5
1, 7
4, 8
3, 7
1, 2
1, 3
7, 8
5, 6
2, 5
5, 7
1, 5
1, 6
2, 8
1, 4
4, 6
2, 6
6, 8

N = 9 (36)

1, 2
5, 7
1, 4
4, 5
1, 3
7, 9
1, 7
6, 9
2, 8
4, 9
4, 6
2, 4
8, 9
4, 7
2, 3
1, 9
6, 7
3, 5
2, 5
1, 6
3, 7
1, 8
6, 8
2, 9
7, 8
4, 8
5, 9
5, 6
1, 5
3, 6
3, 8
5, 8
2, 7
2, 6
3, 4
3, 9

N = 10 (45)

1, 10
3, 9
8, 10
3, 4
2, 6
5, 9
6, 7
7, 8
2, 3
7, 9
4, 9
5, 6
3, 8
2, 4
2, 10
3, 6
7, 10
1, 8
5, 10
3, 7
4, 6
1, 2
9, 10
2, 8
1, 5
3, 5
3, 10
1, 6
2, 9
2, 7
1, 7
1, 4
1, 9
4, 10
1, 3
5, 7
4, 8
6, 8
8, 9
5, 8
6, 10
4, 5
2, 5
4, 7
6, 9

Exhibit 2, Random Order Lists, Con't.

N = 11 (55)

4, 6	7, 11
1, 9	2, 6
3, 7	5, 11
2, 7	2, 9
8, 11	9, 10
3, 5	6, 7
5, 10	
8, 10	
1, 11	
1, 3	
3, 6	
2, 5	
4, 9	
5, 8	
6, 9	
7, 10	
2, 3	
1, 7	
2, 8	
3, 11	
10, 11	
1, 6	
6, 8	
4, 7	
4, 8	
3, 9	
9, 11	
1, 2	
2, 4	
4, 10	
6, 10	
5, 9	
1, 8	
3, 8	
4, 11	
7, 8	
1, 10	
2, 11	
2, 10	
3, 10	
7, 9	
5, 7	
4, 5	
1, 5	
3, 4	
5, 6	
8, 9	
1, 4	
6, 11	

N = 12 (66)

10, 12	1, 8
7, 9	2, 5
1, 3	1, 10
1, 9	8, 11
8, 9	5, 6
5, 12	6, 11
2, 12	5, 10
8, 12	5, 11
2, 9	2, 4
1, 5	6, 7
1, 2	2, 11
6, 12	3, 7
5, 7	10, 11
4, 9	1, 12
4, 6	11, 12
5, 8	6, 8
2, 7	7, 12
1, 11	
3, 11	
3, 12	
4, 12	
4, 8	
7, 11	
9, 12	
2, 3	
6, 10	
1, 7	
1, 4	
4, 11	
4, 7	
6, 9	
3, 10	
1, 6	
3, 9	
9, 11	
5, 9	
2, 10	
9, 10	
2, 6	
7, 10	
4, 5	
3, 4	
7, 8	
3, 6	
8, 10	
3, 5	
4, 10	
3, 8	
2, 8	

Exhibit 2, Random Order Lists, Cont'd.

N = 13 (78)

8, 13	2, 10
2, 6	12, 13
3, 5	1, 10
1, 4	3, 9
2, 4	9, 11
4, 5	9, 10
4, 8	11, 12
7, 8	11, 12
5, 6	3, 13
8, 9	7, 12
1, 13	3, 11
1, 3	8, 10
2, 13	1, 9
4, 6	5, 13
3, 8	6, 12
7, 9	4, 7
6, 11	4, 10
2, 9	10, 12
3, 4	4, 13
5, 9	3, 7
1, 7	9, 12
3, 6	2, 7
2, 8	2, 12
5, 8	2, 11
4, 9	2, 5
5, 7	6, 9
1, 5	8, 11
5, 11	6, 8
8, 12	
7, 10	
1, 12	
6, 7	
1, 2	
3, 10	
1, 6	
9, 13	
5, 12	
7, 11	
4, 11	
6, 10	
10, 13	
3, 12	
2, 3	
1, 11	
10, 11	
4, 12	
1, 8	
7, 13	
6, 13	
5, 10	

N = 14 (91)

4, 10	1, 6
10, 12	7, 8
3, 5	8, 11
3, 10	1, 14
7, 11	11, 13
6, 13	2, 14
8, 9	6, 12
8, 9	6, 12
2, 9	2, 13
6, 11	3, 7
4, 9	1, 4
3, 11	1, 9
5, 8	5, 7
4, 8	2, 5
2, 6	9, 10
10, 14	9, 11
10, 11	9, 13
13, 14	1, 8
5, 13	4, 6
5, 12	3, 13
1, 7	2, 11
8, 12	7, 10
4, 12	3, 6
8, 13	2, 7
3, 4	7, 14
1, 11	5, 11
1, 5	4, 14
3, 8	5, 9
5, 6	12, 13
6, 8	1, 3
9, 14	8, 10
4, 7	7, 13
1, 10	2, 8
4, 5	2, 12
2, 4	4, 13
1, 2	10, 13
6, 7	6, 9
8, 14	2, 3
4, 11	2, 10
11, 14	7, 12
3, 9	9, 12
6, 10	
12, 14	
1, 13	
3, 12	
7, 9	
11, 12	
5, 10	
3, 14	
5, 14	

Exhibit 2, Random Order Lists, Cont'd.

N = 15 (105)

2, 8	1, 4	6, 7
7, 13	7, 11	5, 13
2, 4	8, 15	8, 13
2, 14	13, 15	
6, 8	6, 9	
2, 12	2, 15	
9, 14	10, 14	
2, 13	5, 11	
3, 7	12, 15	
9, 10	5, 14	
4, 12	7, 12	
1, 10	11, 12	
1, 2	6, 15	
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