SCALING GROUP TASKS

A METHOD FOR DIMENSIONAL ANALYSIS

Marvin E. Shaw

University of Florida

Gainesville, Florida

Technical Report No. 1

July, 1963

Scale Analysis of Group Tasks

Office of Naval Research Contract NR 170-266, Nonr-580(11)

Marvin E. Shaw, Principal Investigator

SCALING GROUP TASKS: A METHOD FOR DIMENSIONAL ANALYSIS

Marvin E. Shaw

University of Florida

Gainesville, Florida

Technical Report No. 1

July, 1963

Scale Analysis of Group Tasks

Office of Naval Research Contract NR 170-266, Nonr-580(11)

Marvin E. Shaw, Principal Investigator

ACKNOWLEDGMENTS

The author wishes to express his appreciation to the several persons who contributed to this project: to Edwin D. Lawson and Wilson W. Kimbrough, Jr., for their helpful suggestions and assistance in collecting the data, to Arthur M. Cohen, Clinton B. DeSoto, Fred E. Fiedler, Wilson Guertin, John T. Lanzetta, Joseph E. McGrath, Thornton B. Roby, Edgar H. Schein, Warren S. Torgerson, and Robert C. Ziller for their advice and encouragement at several stages of the investigation, and to William T. Penrod, Jr., William F. Stone, Michael Blum, and Shirley Nichols for their assistance in collecting and analyzing the data. The financial support of the Group Psychology Branch, Office of Naval Research, is gratefully acknowledged.

A B S T R A C T

Scaling Group Tasks: A method for Dimensional Analysis

Marvin E. Shaw

University of Florida

A method for scaling small group tasks is described, patterned after the Thurstone and Chave attitude scaling technique. Ten dimensions of group tasks were tentatively identified, and 104 group tasks were scaled on each of the 10 dimensions. Limited evidence suggests that the obtained scale values are reasonably reliable and valid.

Two factor analyses were completed to determine the degree of independence among the a priori task dimensions. On the basis of the results of these analyses and on certain theoretical grounds, six task dimensions were retained from the original set and described more fully. These dimensions are labelled as follows: Difficulty, Cooperation requirements, Solution multiplicity, Intellectual-manipulative requirements, Intrinsic interest, and Population familiarity.

Some of the possible applications of the method are outlined and some suggestions for improving the scaling procedure are listed.

Scaling Group Tasks: A Method for Dimensional Analysis

Marvin E. Shaw

University of Florida

The importance of small group behavior has been increasingly recognized during the past several years. Along with this recognition has come a rapid acceleration in small group research. One consequence of this rapid growth has been the accumulation of a mass of experimental data, but little theoretical analysis. Thus wide gaps exist in the experimental literature; some factors influencing group behavior have received much attention, whereas others have been grossly neglected. One such variable is the group task. This neglect, however, does not appear to be due to a lack of recognition of the importance of the task as a variable. Several years ago, Carter (1952) suggested that the major determinants of group behavior are the kinds of persons who compose the group, the nature of the tasks and goals of the group, and the structure of the group. The importance of the task also is implied by Cartwright and Zander (1953) in their discussion of group goals and group locomotion. Similarly, more recent theories of group behavior have found it necessary to account for the effects of the group task upon group interaction (Thibaut & Kelly, 1959; Stogdill, 1959; Bass, 1960a).

Research findings likewise indicate the importance of the group task for group behavior. For example, conflicting results are sometimes obtained when different tasks are used (Leavitt, 1951; Shaw,

1954a), and these may be explained, in part, by taking the group task into account (Flament, 1958; Shaw, 1954b). The few studies that have treated group tasks as a main variable have shown the important contribution it makes to the understanding of group behavior (Carter, et al., 1951; Lanzetta & Roby, 1956, 1957; South, 1927; Thorndike, 1938; Willis & Joseph, 1959).

Despite the obvious significance of the group task in the determination of group behavior, very little has been done to identify or scale task dimensions. Researchers interested in other group problems are unable to select a set of tasks that are even roughly similar with respect to a common dimension such as difficulty, except by some untried pre-test procedure or quasi-logical analysis. Although a number of research projects have been concerned with the systematization and generalization of findings regarding group behavior (e.g., McGrath, et al., 1957, 1958; Altman & McGrath, 1959; Glanzer & Glaser, 1959), there seems to be only one article that deals directly with the problem of analysis and classification of tasks. Roby and Lanzetta (1958) attempted a logical analysis of tasks in relation to the overall group-task system, based upon input and output activities of groups. Although they were able to specify a system of classification which may be applied to any group task, their system does not appear to be particularly helpful to the investigator who wants to equate tasks along other relevant dimensions or to vary tasks along some specified dimension.

The dearth of research on tasks is due, in part, to the deficiency of the theoretical formulations. In fact, it is doubtful that a comprehensive theory of group interaction is possible until

considerably more is known about the relationships among the several variables influencing group behavior. Carter's classification of variables influencing group behavior into member characteristics, group structure, and group tasks has been most helpful in the present research. It is recognized that these variables interact, but it is believed that it is possible to vary one factor (for example, group task) independently of other factors (for example, member characteristics).

The present research, then, is based upon the assumption that it is possible to identify at least some important characteristics of tasks qua tasks which can be scaled independently of other group variables. The relationship of task variables to group process and performance variables may very well be different for different group compositions and structures. However, this is regarded as an empirical question that can only be investigated adequately after the various classes of group variables (structure, composition, and task) have been analyzed and relevant dimensions identified and scaled.

The present research attacks only one facet of this overall problem, namely, the identification and scaling of task dimensions. Only those task dimensions that have meaning independent of the particular groups that may attempt to solve them are considered.

The first section of this paper describes the procedures used in collecting group tasks, identifying tentative task dimensions, and scaling tasks along these dimensions. The second section presents the results of the scaling procedure and evidence concerning the reliability and validity of the dimensional scale values. The third section reports the outcome of two factor analyses applied to the scale values.

The fourth section outlines the task dimensions derived from the factor analyses and from certain theoretical considerations. The fifth, and final, section briefly discusses some applications of the dimensional analysis of tasks to small group research, and offers some suggestions for improving the effectiveness of the procedure for scaling group tasks.

Method

The procedure was divided into three steps or phases. Phase I involved the collection of a set of group tasks suitable for analysis. These tasks were obtained from several sources: the experimental literature, investigators in the field of small group research, and tasks formulated especially for this project. Tasks drawn from the experimental literature and from other investigators were modified whenever necessary to make them conform to the requirements of the project. Tasks that were formulated for the project were based upon the investigator's own experience, parlor games and puzzles of various sorts. The 104 tasks collected by this procedure are shown in Appendix A. "Source" refers to the stimulus for the idea, and does not necessarily mean that the task was lifted verbatim from the report. Whenever possible, additional references are given for articles reporting research using the task.

Phase II was devoted to a preliminary identification of tasks dimensions. This was a trial-and-error, quasi-logical process. The investigator formulated and defined several dimensions on the basis of his own work with small problem-solving groups. These were submitted to several social psychologists who were experienced in small

group research for their comments and criticisms. They were also asked to suggest other dimensions that seemed important to them. Those dimensions agreed upon by 50% of the consultants were retained for further analysis. The following dimensions are the result of this procedure:

Cooperation requirements. The degree to which integrated action on the part of group members is required in order to complete the task. By this is meant the number of persons who are dependent on one another for performances of functions required for task solution, and the amount of such dependence. (For example, a task which required for solution that Person A perform action a_1 at the same time that Person B performs action a_2 would have higher cooperation requirements than a task which did not involve these integrated actions, but would have lower cooperation requirements than a task which required that Person A perform actions a_1, b_1, and c_1 at the same time that Person B performs actions a_2, b_2, and c_2, respectively. In short, cooperation requirements refers to the degree to which goal attainment depends upon mutually interrelated action by group members.)

Decision verifiability. The degree to which the "correctness" of the solution or decision can be demonstrated, either by appeal to authority (e.g., the 1960 census), by logical procedures (e.g., mathematical demonstration), or by feedback (e.g., examination of consequences of the decision, as in action tasks.)

Difficulty. Amount of effort required to complete the task (e.g., time to solve, number of errors or failures to complete, etc., would be measures of difficulty).

Goal clarity. The degree to which the requirements of the task are clearly stated or known to the group members.

Goal path multiplicity. The degree to which the task can be solved by a variety of procedures (number of different paths to the goal, number of alternatives for solution, number of different ways that the task can be completed).

Intellectual-manipulative requirements. The ratio of mental requirements to motor requirements. (For example, a task which requires only reasoning-thinking activities would be highest on this dimension; those requiring only motor skills, such as placing pegs in holes, would be lowest; and one that requires both mental and motor activities, such as deciding which pegs to put in which holes and doing same would be somewhere between the two extremes.)

Intrinsic interest. The degree to which the task in and of itself is interesting, motivating, or attractive to group members.

Operational requirements. The number of different kinds of operations or skills (number of specialized operations) required to

complete the task. This includes number of different types of skills or knowledge needed for task solution.

Population familiarity. The degree to which the task is commonly encountered in the larger society; i.e., the probability that the members will have had prior experience with the class of tasks to which the task belongs.

Solution multiplicity. The degree to which there is more than one "correct" solution. (Some tasks, e.g., arithmetic problems, have only one solution that is acceptable; others have two or more, e.g., a sorting task where items to be sorted have several dimensions; and still others have almost an infinite number of possible solutions, e.g., human relations problems or matters of opinion.)

Phase III involved the scaling of tasks along these dimensions. The procedure followed was essentially the Thurstone and Chave (1929) procedure for scaling attitude items. The set of 104 tasks assembled in Phase I was given to 49 judges who sorted them into eight categories (or piles) representing different positions on the dimension under consideration. All judges except two were graduate students in psychology at the University of Florida, New York State University, or the University of Arkansas. The two exceptions were social psychologists with experience in the small group research area. There was no evidence that their responses differed from those of the graduate students. Each judge sorted the tasks on all dimensions, but no one sorted tasks on more than one dimension on a given day, and usually the sortings were separated by several days. The orders in which dimensions were sorted by the various judges were random, and the set of tasks was shuffled by E before each sorting. Each task was typed on a separate sheet which included all the information given in Appendix A except that portion relevant to task dimensions and source.

For a given dimension, the judge was given the set of tasks, a definition of dimension (exactly as given above), and a copy of the

following instructions:

1. The sheets you have been given contain information about group tasks. These have been selected from a variety of tasks used in small group research projects reported in psychological journals.

   As a first step in assigning scale values to these tasks, we want a number of persons to sort them into 8 piles. You will probably find it easier to sort them if you look over a number of tasks, chosen at random, before you begin to sort.

2. Steps in sorting:

   a. You have been given 8 manila envelopes with letters on them. Please arrange these before you in regular order.

   b. Begin by sorting the tasks into four piles. On envelope A place those tasks that you believe are highest with regard to the dimension (name of dimension). On envelope C place the tasks that are next highest on this dimension; on envelope E those that are next highest; and on envelope G those that are lowest with regard to the dimension (name of dimension).

   c. When you have completed step b, divide each of the piles into two more piles to make a total of 8 piles more or less evenly distributed along the scale. For example, those tasks you have placed on envelope A should be divided so that those that are highest on the dimension in question are placed on A and those that are next highest are placed on B; similarly, those on envelope C are divided and placed on envelopes C and D; etc.

   d. Reconsider, look back and forth from pile to pile, reshuffle tasks as much as may be necessary to be sure that you have each task in the pile that you think it should be in.

3. DO NOT TRY TO GET THE SAME NUMBER IN EACH PILE. THEY ARE NOT NECESSARILY EVENLY DISTRIBUTED ALONG THE DIMENSION.

4. In any case in which you may consider it important, you may assume the following conditions:

   a. The instructions listed on the task sheet are minimal; it is assumed that they are understood by all group members.

   b. The first of the several criteria listed is the one to be used in evaluating group performance on the task.

   c. The size of the group is five persons.

   d. Subjects are selected randomly from a population of college undergraduates.

e. The group is unstructured; that is, no structure is imposed on the group, no leader is assigned, no restrictions are placed on communication channels, etc., except as specified on the task information sheet.

5. When you have completed the sorting, please place each pile in the corresponding envelope and return to me.

When the sorting had been completed, the judge placed each pile of tasks in an appropriately labelled manila envelope and returned them to E, who recorded the responses.

Results of the Scaling Procedure

Computation of Scale and Q values

Following Thurstone and Chave (1929), scale values for each task were computed as the median of the distribution of judgments. Medians were computed by formula, however, rather than by the graphic procedure used by Thurstone and Chave. The interquartile range (Q) was taken as the measure of consistency. Again following Thurstone and Chave, when more than half of the judges placed a task in either end category, Q was estimated by doubling the distance between the 50th percentile and the 25th percentile for the high end of the distribution, or between the 50th and 75th percentile for the low end of the distribution. This procedure probably overestimates the Q for those cases.

For each task, then, an estimate of the scale value and of the reliability of the estimate was computed for each of the 10 dimensions. These values are shown below each task in Appendix A. The means and standard deviations of the scale values assigned to tasks on each of the 10 dimensions are given in Table 1. Examination of this data indicates clearly that judges were sorting the tasks

Table 1

Means and Standard Diviations of Scale Values on the Various Task Dimensions

Dimension	Mean	S.D.
Cooperation requirements	3.55	1.58
Decision verifiability	5.76	2.18
Difficulty	3.89	1.23
Goal clarity	5.35	1.18
Goal path multiplicity	3.68	1.77
Intellectual-manipulative requirements	5.95	1.69
Intrinsic interest	3.94	1.24
Operational requirements	3.40	1.29
Population familiarity	3.83	1.24
Solution multiplicity	2.56	2.36

differently for the different dimensions, and that they were discriminating among tasks within each dimension.

Interjudge Reliability

Obtained Q values ranged from 0.54 to 5.30, although only one Q value exceeded 5.00. For purposes of evaluating the consistency of judgments, an arbitrary criterion of Q equal to or less than 3.00 was adopted. Of the 1040 Q values computed, 739 (or approximately 71%) were less than 3.00. On the basis of this criterion, it appears that judges were reasonably consistent, although some tasks were sorted inconsistently on most dimensions.

The three most consistent dimensions were Intellectual-manipulative requirements, Cooperation requirements, and Solution multiplicity. By our criterion, 99, 98, and 96 of the 104 tasks were consistently placed on these dimensions, respectively. By far, the most inconsistent dimension was Goal clarity, with only 34 tasks consistently placed by our criterion. Number of tasks consistently placed for other dimensions were as follows: Decision verifiability, 80; Difficulty, 64; Goal path multiplicity, 81; Intrinsic interest, 62; Operational requirements, 82; and Population familiarity, 63.

One further bit of evidence regarding interjudge reliability is available from an earlier pilot study. Eighteen judges sorted 40 arithmetic type tasks on the Difficulty dimension and on a dimension not included in the present study: Goal path clarity. Scale values were computed using the sortings of 9 judges obtained by one E and separately for sortings of the other 9 judges who were recruited by another E. The product-moment correlations between these two sets of scale values were +.90 for the Difficulty dimension and +.89 for

Goal path clarity. Further, six of the arithmetic tasks used in the pilot study were included in the present investigation (tasks number 24 through 29 in Appendix A). Scale values for the Difficulty dimension from the pilot study (based on 18 judges) correlated +.93 with the scale values obtained in the present study.

From the evidence presently available, the interjudge reliability of the scale values seems to be at least minimally satisfactory.

Validity of Scale Values

Unfortunately, evidence regarding the validity of scale values is quite limited. Perhaps the best evidence comes from the pilot study referred to above. The Difficulty dimension provides the best opportunity to evaluate validity, since the actual performance of groups (e.g., time and error scores) serves as a reasonably good criterion. In a study designed for another purpose, Lawson (1961) required groups of four persons each to solve 20 arithmetic problems, all of which were included in the pilot study. Dr. Lawson was kind enough to provide the error scores earned by his groups on these problems. The scale values for Difficulty obtained in the pilot study correlated +.64 with these error scores.[1] When it is remembered that the tasks were solved (in counterbalanced order) under a variety of experimental conditions (different communication networks and different days), this correlation becomes quite respectable.

Also for another purpose, the author (Shaw, 1954a) obtained data on four of the 40 arithmetic tasks included in the pilot study. Scale values for Difficulty and time scores correlated +.80. This correlation is higher than for the Lawson data, probably a random

[1]All correlation coefficients reported are Pearson *r*'s.

variation due to the extremely small number of cases. It is possible, however, that the higher correlation is due to the fact that time scores were used as the criterion, since this criterion had been used by the judges in the sorting procedure.

The Difficulty scale values obtained in the present study for the six arithmetic tasks included in the Lawson study also were correlated error data. The resulting r was +.79, which compares with the two values reported above.

In general, the estimates of validity obtained by correlating group performance scores with scale values on the Difficulty dimension are encouraging. In view of the fact that the performance scores were obtained under a variety of experimental conditions, the validity coefficients are surprisingly high. We may conclude that the scaling procedure is valid for the difficulty dimension, although it does not necessarily follow that it is valid for the other dimensions.

The validity of scale values for the other dimensions may be evaluated by determining how useful they are in organizing and understanding data relevant to group behavior; i.e., in terms of construct validity. That other dimensions may have some validity for this purpose is indicated by a recent application by Fiedler (1963). He proposed a model for the prediction of group performance which attempts an integration of group effectiveness research with ASo and LPC scores on 21 different types of groups. This model is based upon the assumption that the type of leadership behavior required for effective group performance is contingent upon the favorableness of the group-task situation for the leader. Decision verifiability, Goal clarity, Goal path multiplicity, and Solution multiplicity were

used to operationally define task structure. Previously obtained data were then classified in accordance with three major dimensions: affective leader-member relations, task structure, and leader-position power. A plot of leader attitudes and behaviors against the favorableness of the situation for the leader produced a U-shaped curve, which Fiedler interpreted as indicating that controlling, managing, directive attitudes are required for conditions which are very favorable or unfavorable to the leader, while permissive, non-directive, and considerate behavior is required for moderately unpleasant or unfavorable group-task situations. The significance of this model for the present research is that taking into account tasks dimensions contributed to the systematization of group process data, thus demonstrating a degree of construct validity of task dimensions.

In summary, it is concluded that the scaling approach yields scale values that are at least reliable and valid enough to merit further analysis.

Factor Analysis of Task Dimensions

Since the tasks dimensions that we have been considering are a priori dimensions based upon quasi-logical analysis, the question of independence is of some concern. In attempting to determine the degree of independence among dimensions, two factor analyses were performed using the scale values obtained from the sorting procedure. The first analysis was based upon the 1040 scale values computed for the 104 tasks on all 10 dimensions. Table 2 shows the rotated factor loadings, and Table 3 shows the correlations among dimensions.

Table 2

Rotated Factor Loadings (104 tasks and 10 dimensions)

	Factor I	Factor II	Factor III	Factor IV
Cooperation requirements	0.1606	0.1168	-0.5917	0.0648
Decision verifiability	-0.1458	-0.7899	0.0355	-0.2892
Difficulty	0.8520	-0.1263	0.0967	-0.0148
Goal clarity	-0.6180	-0.2096	0.2426	0.0657
Goal path multiplicity	0.2100	0.9436	-0.0208	0.2682
Intellectual-manipulative requirements	0.0554	0.1298	0.6270	0.4125
Intrinsic interest	0.2145	0.6337	-0.2847	0.4561
Operational requirements	0.7643	0.4156	-0.1998	0.2536
Population familiarity	-0.0417	0.3847	0.1460	0.6452
Solution multiplicity	-0.0240	0.9931	-0.0231	0.0471

Table 3

Intercorrelations Among a priori Task Dimensions
(104 tasks, 10 dimensions)

	1	2	3	4	5	6	7	8	9	10
1. Difficulty										
2. Goal clarity	-.54		I							
3. Operation requirements	.65	-.68								
4. Decision verifiability	.02	.29	-.52			II				
5. Goal path multiplicity	.05	-.31	.59	-.89						
6. Intrinsic interest	.05	-.28	.58	-.70	.67					
7. Solution multiplicity	-.15	-.20	.38	-.90	.91	.58				
8. Cooperation requirements	.05	-.28	.32	-.14	.18	.26	.10	III		
9. Intellectual-manipulative requirements	.13	.16	.04	-.22	.20	.05	.07	-.40		
10. Population familiarity	-.12	.08	.25	-.47	.44	.42	.33	.04	.46	IV

Note: Correlations among dimensions heavily loaded on a common factor are enclosed in boxes. The common factor is indicated by a Roman numeral.

In Table 3, correlations among the dimensions most heavily loaded on each of the four extracted factors are enclosed in boxes. The pattern of intercorrelations makes the interpretations of Factors I, II, and IV relatively easy. However, the low correlation between the two dimensions most heavily loaded on Factor III casts some doubt upon the assumption that Cooperation requirements and Intellectual-manipulative requirements represent different aspects of a single dimension.

In part to help answer the questions raised by Factor III and in part to determine the stability of the factor structure, a second factor analysis was performed using only the most reliable data. Since the Goal clarity dimension appeared to be highly unreliable by our criterion, scale values for this dimension were not included in the second analysis. Similarly, the 34 tasks that were sorted inconsistently (i.e., had Q values larger than 3.00) on three or more of the remaining nine dimensions were eliminated prior to the second analysis. (The tasks not included in the second analysis were those numbered 12, 19-20, 22, 39, 43, 46-50, 52, 57-61, 67, 69, 72-78, 85-89, 99, and 103-104 in Appendix A.)

The rotated factor loadings from the second analysis are presented in Table 4, and Table 5 gives the intercorrelations among dimensions, again with correlations among dimensions loaded on common factors enclosed in boxes. It will be noticed that five, rather than four, factors were extracted in the second analysis, and that there was some shifting in factor loadings. The new factor (Factor V in Tables 4 and 5) is represented by Intrinsic interest, which is the only dimension having a loading on this factor greater than .20.

Table 4

Rotated Factor Loadings (70 tasks, 9 dimensions)

	Factors				
	I	II	III	IV	V
Cooperation requirements	0.1092	0.1673	0.6494	0.0205	0.0199
Decision verifiability	-0.1067	-0.7264	-0.1392	0.2356	-0.1182
Difficulty	0.8515	0.0375	0.0526	0.1538	-0.0006
Goal path multiplicity	0.1321	0.9266	0.2917	-0.1043	0.0806
Intellectual-manipulative requirements	-0.0464	0.0770	-0.2036	-0.7361	0.0159
Intrinsic interest	0.2676	0.6134	0.0488	-0.3033	0.4324
Operational requirements	0.6636	0.5095	0.3353	-0.0241	0,1799
Population familiarity	-0.1127	0.1747	0.2060	-0.7180	0.0637
Solution multiplicity	-0.0099	0.9905	0.0504	-0.0277	-0.0636

Table 5

Intercorrelations Among a priori Task Dimensions for Consistent Dimensions and Tasks (70 tasks, 9 dimensions)

	1	2	3	4	5	6	7	8	9
1. Difficulty		I							
2. Operational requirements	.69								
3. Decision verifiability	-.05	-,60			II				
4. Goal path multiplicity	.20	.69	-,92						
5. Intrinsic interest	.18	.63	-.73	.70	V				
6. Solution multiplicity	.03	.50	-.91	.91	.54				
7. Cooperation requirements	.11	.42	-.21	.39	.15	.18	III		
8. Intellectual-manipulative requirements	-.13	-.07	-.23	.09	.25	.07	-.16	IV	
9. Population familiarity	-.21	.13	-.40	.25	.31	.18	.16	.55	

Note, however, that Intrinsic interest also has a high loading on Factor II, in agreement with the first analysis. Cooperation requirements appears as the only dimension heavily loaded on Factor III, while Intellectual-manipulative requirements has loadings on Factor IV in common with Population familiarity. Factors I and II remained unchanged from the pattern found in the first analysis. An oblique rotation provided no additional information.

In general, the second analysis is regarded as the best evidence concerning independence of dimensions. However, rather than attempt an interpretation of each of the five factors indicated by this analysis, consideration will be given to the meaning of the findings for the identification and description of task dimensions.

Derived Task Dimensions

Based upon the data obtained from the second factor analysis and certain theoretical considerations, the following are believed to be meaningful task dimensions:

Difficulty (Factor I) may be defined as the amount of effort required to complete the task. This, of course, is the same as the original definition of this dimension. Difficulty is influenced by (or perhaps determined by) the number of operations, skills, and knowledges required for successful task completion. Goal clarity is negatively loaded on Factor I, and may be regarded as one aspect of difficulty. Tasks may vary on this dimension from easy, i.e., requiring few operations, skills and knowledges, to difficult, i.e., requiring many operations, skills and knowledges. This is a relatively stable and/or strong dimension.

Solution multiplicity (Factor II) may be defined as the degree to which there is more than one "correct" solution. This is a complex dimension involving number of acceptable solutions, number of alternatives for task completion, and the degree to which acceptable solutions can be verified (i.e., demonstrated to be correct). Solution multiplicity was chosen as the label for this dimension not only because it had the heaviest factor loading, but also because

number of acceptable solutions appears to be the more basic aspect of tasks. Goal path multiplicity (number of alternatives for task completion) and Decision verifiability (degree to which acceptable solutions can be demonstrated to be correct) are probably the consequences of Solution multiplicity. A task that has numerous acceptable solutions will almost necessarily have several alternatives for arriving at these various solutions, and it is very unlikely that any one solution can be demonstrated to be correct. Thus, a task that has a high scale value on Solution multiplicity is one that has many possible solutions that are acceptable, many alternatives for attaining these solutions, and no solution that can be easily verified, whereas a task that has a low scale value on this dimension will have a single acceptable solution that can be easily demonstrated to be correct, and a single path to this goal.

Intrinsic interest, although correlated with Solution multiplicity, is not regarded as a necessary aspect of this dimension. This conclusion is based upon two considerations. First, Intrinsic interest was shown to be at least partially independent in the factor structure revealed by the second factor analysis. Second, the correlation with the Solution multiplicity dimension may be due to the particular judges used in this study. Graduate students no doubt find the complex tasks more interesting, and they may have judged the tasks in our sample on the basis of their own feelings.

Cooperation requirements (Factor III) may be defined as the degree to which integrated action of group members is required to complete the task. This dimension corresponds exactly to the original formulation, since it is the only a priori dimension that was loaded on Factor III in the second analysis. Tasks at the high end of the dimensional continuum require that group members coordinate their actions so that each member is performing the proper function at the proper time relative to the actions of other members, whereas a task at the other extreme could be completed by each group member working independently and at his own speed.

Intellectual-manipulative requirements is defined as the ratio of mental requirements to motor requirements. It is retained as a separate dimension despite the fact that it had loadings on Factor IV in common with Population familiarity. This decision is based upon the relatively low correlation between Intellectual-manipulative requirements and Population familiarity, and upon a possible artifact of the judging procedure. Since the judges were graduate students in psychology, their recent experiences had been with tasks of the mental type; hence it seems likely that these tasks would appear more familiar to them. This may account for the observed correlation between the two dimensions.

Tasks at the high end of the dimension require only mental (reasoning, thinking) activities for completion, whereas those at the opposite extreme require only motor (physical) activities for successful task completion.

Population familiarity is retained in its original form and may be defined as the degree to which the task is encountered by members

of the larger society. It is regarded as a separate dimension for the reasons given above, but appears to be a relatively weak dimension. Tasks that are high on Population familiarity are familiar to most, it not all, members of the society; those at the other end of the dimension are familiar to no one, or to very few, members of the society.

Intrinsic interest (Factor V) is defined as the degree to which the task in and of itself is interesting, motivating, or attractive to the group members. As discussed above, it has moderately heavy loading on Factor II in addition to being the only dimension with a sizeable loading on Factor V. Reasons for regarding it as an independent dimension have already been discussed. In general, it is regarded as a weak dimension. Although it may be a "true" dimension of tasks, it is probably more accurately identified as a relation between the individual and the task. At best, it is confounded with the personal element, and the judging procedure does not appear to be suitable for scaling tasks on this dimension.

Of the six dimensions described above, the first three (Difficulty, Solution multiplicity, and Cooperation requirements) show the greatest promise of understanding group process. These three dimensions are relatively stable and strong dimensions in the sense that judgments are consistent and the factor structure is relatively stable. Intellectual-manipulative requirements and Population familiarity are ambiguous in that the factor structure is relatively unclear. Intrinsic interest is also vague in that the factor structure is confused and scale values obtained in the present study do not appear to be independent of the judges' own experiences.

In summary, it is believed that the data obtained from the research reported in this paper support the conclusion that meaningful, independent task dimensions have been identified, and that tasks can be assigned reliable and valid scale values on these dimensions by means of the judging procedure. There is no suggestion, however, that the list of dimensions given above is exhaustive; other, and perhaps more significant, task dimensions may be revealed by further analysis.

Discussion and Conclusions

Applications

The identification and description of task dimensions promises to greatly facilitate the experimental analysis of small group behavior. Several applications seem obvious. First, tasks having approximately the same dimensional characteristics may be more readily identified, thus enabling the experimenter to test groups on a series of trials without the usual confounding of practice and task effects. (Of course, such confounding can be statistically unraveled by appropriate experimental design and analysis, but such procedures are relatively complicated.) Second, tasks may be selected to vary along one or more dimensions, while remaining relatively constant along the other dimensions. Thus, the relationships between task dimensions and group process variables may be determined. Third, the inclusion of task dimensions as a part of the total situation may be expected to contribute to the theoretical interpretation of relations between other, non-task, group variables. An example of this type of application is Fiedler's (1963) use of task structure to systematize the observed relationships between the leader's LPC/ASo scores and group performance scores.

Perhaps these will suffice to indicate the kinds of benefits expected from the analysis of task dimensions, although it is likely that other applications will become apparent as small group research progresses. It is also likely that the scaling procedure will be improved as new insights occur. To this end, several suggestions derived from the present study are presented below.

Suggestions Concerning Scaling Procedures

Some investigators may elect to use the tasks and scale values given in Appendix A; others undoubtedly will prefer to select other tasks and scale them on the dimensions of interest. The following observations are offered as possible benefits to potential users of the method.

1. As in attitude scaling, judges show greater agreement on tasks near the extremes of the dimension than on those near the middle categories.

2. Scale values given in Appendix A are computed to two decimal places. This is obviously optimistic, since scale values are almost certainly not reliable beyond the first decimal place.

3. Consistent scale values probably can be obtained with fewer judges than used in this study. For example, Fiedler (1963) reported interjudge reliabilities ranging from .80 to .88 using only three independent judges who rated 35 tasks on Decision verifiability, Goal clarity, Goal path multiplicity, and Solution multiplicity.

4. When tasks of a particular type are to be used, such as discussion tasks, greater differentiation among tasks can be obtained by scaling them as a part of a homogeneous set. When a heterogeneous set is scaled, as in the present study, there is a tendency for all tasks of a given type to be placed in the same category. In the pilot study involving 40 arithmetic tasks, discrimination among similar tasks was much greater than in the larger study.

5. Dimensions must be defined with great care. Although much time and thought was given to definitions in the present study, it nevertheless appeared that the dimensions that were given the most

detailed definitions were the ones that yielded the most consistent scale values. Redundant definitions are indicated.

6. Finally, by analogy to the scaling of attitude items, one may suspect that approximately the same results could be obtained by substituting means for medians as scale values, graphic ratings for the sorting procedure, and/or a different number of intervals or categories for the eight we have used.

In conclusion, it is believed that the Thurstone method of scaling has been demonstrated to be applicable to the scaling of group tasks, and that such application will contribute to the further analysis of small group behavior. The procedure is far from perfect, but further research may be expected to lead to significant improvements.

References

Altman, I., & McGrath, J. E. A Conceptual Framework for the Integration of Small Group Research Information. Arlington, Va.: Human Sciences Research, Inc., 1959.

Bass, B. M. An analysis of leaderless group discussion. J. appl. Psychol., 1949, 33, 527-533.

Bass, B. M. Effects of motivation on consistency of performance in groups. Tech. Rept. No. 16, Contract N7 ONR 35609, Louisiana State University, Baton Rouge, Feb., 1958.

Bass, B. M. Leadership, Psychology, and Organizational Behavior. New York: Harper & Bros., 1960a.

Bass, B. M. An evaluation of the use of objective social data for training problem-solving discussants. Tech. Rept. 22, Contract N7 ONR 35609, Louisiana State University, Baton Rouge, June, 1960b.

Bass, B. M., Pryer, M. W., Gaier, E. L., & Flint, A. W. Interacting effects of control motivation, group practice, and problem difficulty on attempted leadership. J. abnorm. soc. Psychol., 1958, 56, 352-358.

Bavelas, A. Communication patterns in task-oriented groups. J. acoust. soc. Amer., 1950, 22, 725-730.

Blake, R. R., Mouton, J. S., & Fruchter, B. The consistency of interpersonal behavior judgments made on the basis of short-term interactions in three-man groups. J. abnorm. soc. Psychol., 1954, 49, 573-578.

Burack, B. The nature and efficacy of methods of attack on reasoning problems. Psychol. Monogr., 1950, 64, No. 7 (Whole No. 313).

Carter, L. F. Leadership and small group behavior. Paper read at the Second Conference on Social Psychology, University of Oklahoma, April, 1952.

Carter, L. F., Haythorn, W., Shriver, E., & Lanzetta, J. The behavior of leaders and other group members. J. abnorm. soc. Psychol., 1961, 46, 589-595.

Carter, L., Haythorn, W., Meirowitz, B., & Lanzetta, J. The relation of categorizations and ratings in the observation of group behavior. Hum. Relat., 1951, 4, 239-254.

Cartwright, D., & Zander, A. (eds.) Group Dynamics: Research and Theory. Evanston, Ill.: Row, Peterson, & Co., 1953.

Cattell, R. B., Saunders, D. R., & Stice, G. F. The dimensions of syntality in small groups. Hum. Relat., 1953, 6, 331-356.

Cattell, R. B., & Stice, G. F. The dimensions of groups and their relations to the behavior of members. Champaign, Ill.: Institute of Personality and Ability Testing, 1960.

Cleveland, S. E., & Fisher, S. Prediction of small group behavior from a body image schema. Hum.Relat., 1957, 10, 223-233.

Cohen, D., Whitmyre, J. W., & Funk, W. H. Effect of group cohesiveness and training on creative thinking. J. appl. Psychol., 1960, 44, 319-322.

Crutchfield, R. S. Assessment of persons through a quasi-group interaction technique. J. abnorm. soc. Psychol., 1951, 46, 577-588.

Deutsch, M. An experimental study of the effects of cooperation and competition upon group process. Hum. Relat., 1949, 2, 199-231.

Exline, R. V., & Ziller, R. C. Status congruency and interpersonal conflict in decision making groups. Hum. Relat., 1959, 12, 147-162.

Festinger, L., & Hutte, H. An experimental investigation of the effect of unstable interpersonal relations in a group. J. abnorm. soc. Psychol., 1954, 49, 513-522.

Fiedler, F. E. A contingency model for the prediction of leadership effectiveness. Urbana, Ill.: Group Effectiveness Research Laboratory, University of Illinois, 1963. (Tech. Rept. No. 10, ONR Contract NR 177-472, Nonr-1834(36), May, 1963.)

Flament, C. La performance des groupes de travail: Rapports entra la structure de l'activité et celle du reséau de communication. Année Psychol., 1958, 57, 71-89.

French, J. R. P., Jr. The disruption and cohesion of groups. J. abnorm. soc. Psychol., 1941, 36, 361-377.

Gaier, E. L., & Bass, B. M. Effects of city familiarity on size estimation. Tech. Note 1, Contract N7 ONR 35609, Louisiana State University, Baton Rouge, November, 1955.

Ghiselli, E. E., & Lodahl, T. M. Patterns of managerial traits and group effectiveness. J. abnorm. soc. Psychol., 1958, 57, 61-66.

Gilchrist, J. C. The formation of social groups under conditions of success and failure. J. abnorm. soc. Psychol., 1952, 47, 174-187.

Glanzer, M., & Glaser, R. Techniques for the study of group structure and behavior: I. Analysis of structure. Psychol. Bull., 1959, 56, 317-332.

Goldberg, S. C. Influence and leadership as a function of group structure. J. abnorm. soc. Psychol., 1955, 51, 119-122.

Heise, G. A., & Miller, G. A. Problem solving by small groups using various communication nets. J. abnorm. soc. Psychol., 1951, 46, 327-335.

Hoffman, L. R. Homogeneity of member personality and its effect on group problem solving. J. abnorm. soc. Psychol., 1959, 58, 27-32.

Hoffman, L. R., & Maier, N. R. F. Sex differences, sex composition and group problem-solving. J. abnorm. soc. Psychol., 1961, 63, 453-456.

Katz, I., Goldston, J., & Benjamin, L. Behavior and productivity in bi-racial work groups. Hum.Relat., 1958, 11, 123-141.

Lanzetta, J. T., & Roby, T. B. Effects of work-group structure and certain task variables on group performance. J. abnorm. soc. Psychol., 1956, 53, 307-314.

Lanzetta, J. T., & Roby, T. B. Group learning and communication as a function of task and structure "demands." J. abnorm. soc. Psychol., 1957, 55, 121-131.

Laties, V. G. Modification of affect, social behavior and performance by sleep deprivation and drugs. J. psychiat. Res., 1961, 1, 12-25.

Lawson, E. D. Change in communication nets and performance. Paper read at the 1961 Eastern Psychological Convention.

Leavitt, H. J. Some effects of certain communication patterns on group performance. J. abnorm. soc. Psychol., 1951, 46, 38-50.

Maier, N. R. F. Reasoning in humans: I. On direction. J. comp. Psychol., 1930, 10, 115-143.

Maier, N. R. F. An aspect of human reasoning. Brit. J. Psychol., 1933, 24, 144-155.

Maier, N. R. F. An experimental test of the effect of training on discussion leadership. Hum. Relat., 1953, 6, 161-173.

Maier, N. R. F., & Solem, A. R. The contribution of a discussion leader to the quality of group thinking: The effective use of minority opinions. Hum. Relat., 1952, 5, 277-288.

Marquart, D. I. Group problem solving. J. soc. Psychol., 1955, 41 103-113.

McGrath, J. E. A Framework for Integration of Small Group Research Studies. Arlington, Va.: Psychological Research Associates, 1957.

McGrath, J. E., & Altman, I. A Model for Integration of Small Group Research Information. Arlington, Va.: Human Sciences Research, Inc., 1958.

Parnes, S. J., & Meadow, A. Effects of "brainstorming" instructions on creative problem solving by trained and untrained subjects. J. educ. Psychol., 1959, 50, 171-176.

Pepinsky, P. N., Hemphill, J. K., & Shevitz, R. N. Attempts to lead, group productivity, and morale under conditions of acceptance and rejection. J. abnorm. soc. Psychol., 1958, 57, 47-54.

Peterson, G. M. An empirical study of the ability to generalize. J. gen. Psychol., 1932, 6, 90-114.

Roby, T. B., & Lanzetta, J. T. An investigation of task performance as a function of certain aspects of work-group structure. Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, June, 1956. (Res. Rept. AFPTRC-TN-56-74)

Roby, T. B., & Lanzetta, J. T. Considerations in the analysis of group tasks. Psychol. Bull., 1958, 55, 88-101.

Shaw, Marjorie E. A comparison of individuals and small groups in the rational solution of complex problems. Amer. J. Psychol., 1932, 44, 491-504.

Shaw, M. E. Some effects of unequal distribution of information upon group performance in various communication nets. J. abnorm. soc. Psychol., 1954a, 49, 547-553.

Shaw, M. E. Some effects of problem complexity upon problem solution efficiency in different communication nets. J. exp. Psychol., 1954b, 48, 211-217.

Shaw, M. E. Some effects of individually prominent behavior upon group effectiveness and member satisfaction. J. abnorm. soc. Psychol., 1959, 59, 382-386.

Shaw, M. E., & Gilchrist, J. C. Repetitive task failure and sociometric choice. J. abnorm. soc. Psychol., 1955, 50, 29-32.

Shaw, M. E., & Rothschild, G. H. Some effects of prolonged experience in communication nets. J. appl. Psychol., 1956, 40, 281-286.

Shaw, M. E., Rothschild, G. H., & Strickland, J. F. Decision processes in communication nets. J. abnorm. soc. Psychol., 1957, 54, 323-330.

Smith, E. E. The effect of clear and unclear role expectations on group productivity and defensiveness. J. abnorm. soc. Psychol., 1957, 55, 213-217.

South, E. B. Some psychological aspects of committee work. J. appl. Psychol., 1927, 11, 437-464.

Stogdill, R. M. Individual Behavior and Group Achievement. New York: Oxford University Press, 1959.

Thibaut, J. W., & Kelley, H. H. The Social Psychology of Groups. New York: John Wiley & Sons, 1959.

Thorndike, R. L. On what type of task will a group do well? J. abnorm. soc. Psychol., 1938, 33, 409-413.

Thurstone, L. L., & Chave, E. J. The measurement of attitudes. Chicago: University of Chicago Press, 1929.

Watson, G. B. Do groups think more efficiently than individuals? J. abnorm. soc. Psychol., 1928, 23, 328-336.

Willis, R. H., & Joseph, M. L. Bargaining behavior. I. "Prominence" as a predictor of the outcome of games of agreement. Conflict Resolution, 1959, 3, 102-113.

Ziller, R. C. Four techniques of group decision making under certainty. J. appl. Psychol., 1957, 41, 384-388.

APPENDIX A

The following tasks were used in the task analysis project. For sorting purposes, judges were given all the information shown below for each tasks, except "source" and, or course, the scale and Q values. "Source" refers to the source of the task in its original form. Occasionally, a task was used in exact original form; however, in most cases the tasks were modified to fit the particular requirements of this project.

Tentatively, tasks have been grouped according to type of task.

Mathematical Puzzles

Task 1

Materials: Paper and pencils. Copy of the following statement of the problem:

Farmer Jones sent his son to market with a number of chickens, telling him that he might sell any or all of them as he thought best. When the son returned he reported to his father as follows, "First, I sold Mr. Smith half of the chickens and $\frac{1}{2}$ more; then I sold Mr. Wilson a third of what remained and 1/3 of a chicken more; next I sold Mr. Thomas 1/4 of what remained and 3/4 of a chicken more; finally, I sold Mr. Norton exactly 1/5 of what I had left and gave him 1/5 of a chicken for his wife. I brought back 19 that I was unable to sell." How many chickens did Farmer Jones send to market?

Instructions: "Your task is to discuss the problem and arrive at a group decision regarding the correct solution."

Solution: Farmer Jones sent 101 chickens to market. (Mr. Smith bought half and 1/2 more, or $50\frac{1}{2} + \frac{1}{2} = 51$; Mr. Wilson bought 16 2/3 + 1/3 = 17; Mr. Thomas bought $8\frac{1}{4} + 3/4 = 9$; Mr. Norton bought 4 4/5 + 1/5 = 5; leaving 19 which were returned home.)

Criteria: Time; correct/incorrect

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.23	2.65
Decision verifiability	7.37	0.62
Difficulty	5.21	2.58
Goal clarity	6.78	2.43
Goal path multiplicity	1.90	1.64
Intellectual-manipulative requirements	7.02	2.26

	Scale value	Q value
Intrinsic interest	2.94	3.48
Operational requirements	3.61	2.13
Population familiarity	4.21	3.23
Solution multiplicity	0.56	0.56

*****

Task 2

Materials: Paper and pencils; copies (one for each S) for the following problem statement:

"Five school girls sat for an examination. Their parents, so they thought, showed an undue degree of interest in the result. They therefore agreed that, in writing home about the examination, each girl would make one true statement and one untrue one. The following are the relevant passages from their letters:

Betty: 'Kitty was second in the examination. I was only third.'
Ethel: 'You'll be glad to hear that I was top. Joan was second'
Joan: 'I was third, and poor Ethel was bottom.'
Kitty: 'I came out second. Mary was only fourth.'
Mary: 'I was fourth. Top place was taken by Betty.'

What, in fact, was the order in which the five girls placed?"

Instructions: "We are interested in observing how groups of individuals go about solving problems. Please read the problem carefully, then discuss it among yourselves and try to arrive at a group dicision as quickly as possible. You may attack the problem in any way that you wish as long as you work on it as a group."

Solution: Kitty, Joan, Betty, Mary, Ethel

Criteria: Number of girls correctly placed; time required for solution.

Source: Deutsch, 1949.

Dimension	Scale value	Q value
Cooperation requirements	2.61	2.63
Decision verifiability	7.21	2.98
Difficulty	4.71	2.27
Goal clarity	5.61	2.50
Goal path multiplicity	3.23	2.29
Intellectual-manipulative requirements	7.12	2.46
Intrinsic interest	4.68	2.59
Operational requirements	3.04	1.98
Population requirements	3.39	2.56
Solution multiplicity	0.77	1.82

*****

Task 3

Materials; Paper and pencils; copies (one for each S) of the following problem statement:

"There must have been a dearth of eligible young ladies in Kingsdale, for each of five men there has married the widowed mother of one of the others. Jenkin's stepson, Tomkins, is the stepfather of Perkins. Jenkin's mother is a friend of Mrs. Watkins, whose husband is a cousin of Mrs. Perkins. What is the name of the stepson of Simkins?"

Instructions: "We are interested in observing how groups of individuals go about solving problems. Please read the problem carefully, then discuss it among yourselves and try to arrive at a group decision as quickly as possible. You may attack the problem in any way that you wish as long as you work on it as a group."

Solution: Watkins

Criteria: Time required for solution; correct/incorrect

Source: Deutsch, 1949.

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.48
Decision verifiability	7.28	1.66
Difficulty	4.28	2.33
Goal clarity	5.71	3.22
Goal path multiplicity	2.66	2.31
Intellectual-manipulative requirements	7.16	1.88
Intrinsic interest	4.17	2.65
Operational requirements	3.14	2.05
Population familiarity	3.23	2.12
Solution multiplicity	0.54	0.56

*****

Task 4

Materials: Paper and pencils; a copy of the problem statement for each group member:

"Eight men entered a tennis tournament at Golfview. The tournament was played in three consecutive days, one round per day. No match was defaulted. The first and second round matches were stipulated to be 2 sets out of 3, whereas the final round was 3 sets out of 5.

After the tournament had ended, the following information about the tournament was widely known:

Easton never played against Henderson.

Before the play began, Gordon remarked to Bentley, 'I see that we meet in the finals.'

Chester won a set at love but lost his first match.

Altogether, 140 games were played, of which the losers won 43.

When the pairings were posted, Anderson said to Dalton, 'Do you concede, or do you want to play it out?'

On the second day, the first round losers played bridge, and at the same table gathered on the third day with Easton in place of Anderson.

Bentley won 9 games.

Francis won 37 games.

The first score of the tournament was a service ace by Gordon, at which Easton shouted, 'Hey,, I'm not over there.

Who won the tournament?"

Instructions: "This is a group task. Work on the task cooperatively, trying to arrive at an answer to the quesrion posed in the problem statement that is agreeable to everyone. If you cannot agree, a minority report will be accepted along with the majority decision. Let me know when you have arrived at an answer."

Solution: Dalton

Criteria: Time require; correct/incorrect; unanimity of decision.

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.31
Decision verifiability	7.16	2.82
Difficulty	5.65	2.70
Goal clarity	5.44	3.81
Goal path multiplicity	3.04	2.53
Intellectual-manipulative requirements	7.12	1.84
Intrinsic interest	4.36	2.71
Operational requirements	4.12	2.02
Population familiarity	3.04	2.82
Solution multiplicity	0.56	0.56

*****

Task 5

Materials: Paper and pencils. Copy of the following problem statement for each group member:

"A certain woman went shopping one day and spent all her money. She visited shops A, B, C, and D, and purchased a saw, a dress, a pair of shoes, and a loaf of bread. She paid a dollar to enter shop A, where she spent half of what she had left for the day. Then she paid a dollar to leave shop A and dollar to enter shop B. In shop B she spent half of what she had left for a dress. She paid a

dollar to get out of shop B and a dollar to enter shop C. In shop C she spent half of what she had left for a pair of shoes. She paid a dollar to leave shop C and a dollar to enter shop D. In shop D she spent half of what she had left for a loaf of bread, and paid her last dollar to get out. How much did she have when she entered shop A?"

Instructions: "This is a group task. Work cooperatively to arrive at a group solution to the problem. When you have an answer, let me know."

Solution: $45

Criteria: Time required; error - deviation from correct answer.

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.04	2.47
Decision verifiability	7.39	0.62
Difficulty	4.63	2.23
Goal clarity	6.25	3.14
Goal path multiplicity	1.77	2.04
Intellectual-manipulative requirements	7.09	1.96
Intrinsic interest	3.56	3.01
Operational requirements	3.21	2.14
Population familiarity	4.81	2.63
Solution multiplicity	0.56	0.56

*****

Task 6

Materials: Paper and pencils. A copy of the following problem statement for each group member of the group:

"Three businessmen - Smith, Jones, and Johnson - all live in the "Capital District" of New York. Three railwaymen - also named Smith, Jones and Johnson - live in the same district. The businessman Johnson and the brakeman live in Albany. The businessman Jones and the fireman live in Schenectedy. The businessman Smith and the engineer live halfway between the two cities. The brakeman's namesake earns $12,500 per year. The engineer earns an even 1/3 of the salary of the businessman living nearest to him. The railwayman Smith beats the fireman at billiards. What is the name of the engineer?"

Instructions: "Your task is to discuss the problem and arrive at a group solution. Attack the problem in any way you wish. Let me know when you have an answer."

Solution: Smith

Criteria: Time required; correct/incorrect; unanimity of opinion.

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.14	2.81
Decision verifiability	7.28	2.40
Difficulty	5.15	2.82
Goal clarity	5.50	4.10
Goal path multiplicity	2.68	2.12
Intellectual-manipulative requirements	7.23	1.64
Intrinsic interest	3.73	2.43
Operational requirements	3.45	2.39
Population familiarity	3.25	2.60
Solution multiplicity	0.58	0.60

*****

Task 7

Materials: Paper and pencils. A copy of the following problem statement for each group member:

"Johnson, Barry, Brewster, Edwards, Adams, and Hunter are each sophomores in one of the following colleges; Yale, Harvard, Princeton, Dartmouth, Cornell, and Columbia. Barry has a girl friend named Miss Short. Miss Phillips is Brewster's girl. Miss Klagg is Hunter's girl. Miss Rice is Johnson's girl. Miss West is Edwards' girl. Miss Phillips doesn't know any Cornell men. Miss Klagg knows no Columbia men. Miss West hates Harvard men. Miss Kent roots for Princeton. Brewster knows Miss West but she won't have anything to do with him. Barry wears a big Y on his sweater. To which college does each man go?"

Instructions: "This is a group task. Work cooperatively to arrive at a group answer to the question posed in the problem statement. When you have an answer, let me know."

Solution: Johnson - Dartmouth
Barry - Yale
Brewster - Harvard
Edwards - Columbia
Adams - Princeton
Hunter - Cornell

Criteria: Number correct pairs; time required.

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.31	2.73
Decision verifiability	7.21	2.72
Difficulty	4.77	2.22
Goal clarity	5.81	3.14
Goal path multiplicity	3.17	2.81
Intellectual-manipulative requirements	7.12	1.70
Intrinsic interest	4.55	2.72
Operational requirements	3.06	2.20
Population familiarity	3.15	2.71
Solution multiplicity	0.77	1.52

*****

Task 8

Materials: Paper and pencils. A copy of the following problem statement for each group member:

"The Wilson family is a well-regulated household. When it turned out en masse to pick blueberries last fall, a separate quota was assigned to men, women, and children. Each quota was a whole number of quarts, and each individual was expected to harvest exactly as many quarts as every other person in his category. The quotas were such that 2 men gathered as many quarts as 3 women and 2 children. Five women gathered as many quarts as 3 men and 1 child. All quotas were filled and the total harvest was 116 quarts. The quota for a woman is 8 times that of a child. The quota for a man is 13 times that of a child. There are five men and six women in the family. How many children are there in the Wilson family?"

Instructions; "Your task is to discuss the problem among yourselves and arrive at a group solution to the problem. Attack the problem in any way that you wish. Please let me know when you have a solution."

Solution: 3 children

Criteria: Time required; error - deviation from correct answer

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.06	2.68
Decision verifiability	7.30	1.10
Difficulty	4.97	2.08
Goal clarity	5.68	3.18
Goal path multiplicity	2.39	2.03
Intellectual-manipulative requirements	7.09	1.96

Dimension	Scale value	Q value
Intrinsic interest	3.36	3.24
Operational requirements	3.50	2.40
Population familiarity	3.72	2.47
Solution multiplicity	0.57	0.56

*****

Task 9

Materials: Paper and pencils. Copy of the following problem statement:

"Two men, John and Paul, were traveling across the desert. When they stopped for lunch, John produced five loaves of bread and Paul three. Just then a stranger, whom we shall call George, appeared and asked if he could join them for lunch. John and Paul agreed. When the meal was finished, all the loaves had been eaten. George laid down eight dimes and said, 'I will leave it to you to decide how the money shall be divided between you.' How should the money be divided? (Assume that all three men to have eaten equal shares of the bread.)"

Instructions: "Discuss the problem you have been given and arrive at a group decision about how the money shall be divided."

Solution: John should get 70¢ (7 dimes) and Paul 10¢ (1 dime). (As each ate an equal share it should be divided equally; thus each ate 8/3 of a loaf. John provided 15/3 and ate 8/3; he must have contributed 7/3 to George's meal. Paul provided 9/3; ate 8/3, and contributed 1/3 to George's meal. Since they contributed to George's meal in the proportions of 7 to 1, they money should be divided likewise.)

Criteria: Time; pass/fail.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.86	2.36
Decision verifiability	7.34	0.66
Difficulty	4.23	2.86
Goal clarity	6.14	3.33
Goal path multiplicity	1.88	2.41
Intellectual-manipulative requirements	7.09	1.96
Intrinsic interest	3.44	2.14
Operational requirements	3.17	1.96
Population familiarity	5.17	2.40
Solution multiplicity	0.57	0.56

*****

Task 10

Materials: Paper and pencils. Copy of the following statement:

"Suppose that there are two chains made up from links of equal size and made of metal ½ inch in diameter. One chain is 16 inches long and the other 6 inches long. There are 6 more links in the longer chain than in the shorter one. How many links are there in each chain?"

Instructions: "Your task is to discuss the problem you have been given and to arrive at a group solution. When you have reached a decision, write your solution on the paper provided and hand it to me."

Solution: The longer chain had 9 links and the shorter one 3. (Length of any chain having equal size links may be found by multiplying the inside diameter of each link by the number of links and adding the product to twice the diameter of the metal used to make the links.)

Criteria: Time; pass/fail.

Source: (Old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.95	2.21
Decision verifiability	7.28	1.34
Difficulty	4.77	2.59
Goal clarity	5.50	3.06
Goal path multiplicity	1.75	2.17
Intellectual-manipulative requirements	6.72	1.54
Intrinsic interest	2.50	2.40
Operational requirements	3.59	2.42
Population familiarity	3.39	2.76
Solution multiplicity	0.56	0.56

*****

Task 11

Materials: Paper and pencils. Copy of the following statement:

"A certain golf course had nine holes, 300, 250, 200, 325, 275, 350, 225, 375, and 400 yards apart, in that order. Assume that a man could always strike the ball in a perfectly straight line and send it exactly one of two distances so that it would either go towards the hole, drop into it, or pass over it. What would the two distances be that would carry him around the whole course in the least number of strokes?"

Instructions: "Working as a group, determine which two distances will carry the golfer around the course in the fewest number of strokes. Using these two distances, compute the number of strokes that will be required."

Solution: 100 yards and 125 yards, requiring 26 strokes. (Good distances are 125 and 75, requiring 28 strokes.)

Criteria: Number of strokes; time.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.83	2.07
Decision verifiability	7.02	2.66
Difficulty	4.23	2.77
Goal clarity	4.72	2.45
Goal path multiplicity	2.78	1.86
Intellectual-manipulative requirements	6.86	2.02
Intrinsic interest	3.34	2.05
Operational requirements	3.35	2.10
Population familiarity	3.94	3.01
Solution multiplicity	1.54	1.80

*****

Task 12

Materials: Paper and pencils. Copy of the following problem statement:

"A man had a barrel of beer and two measures, one holding five pints and one holding three pints. Using only the cask and the two measures, show how it is possible for the man to put exactly one pint into each of the two measures. No other vessels are to be used and no marking of the measures is allowed."

Instructions: "Your task, working as a group, is to arrive at a group solution of the problem posed above."

Solution: Fill the two measures.

Open the tap and let the remainder of the beer in the barrel run to waste.

Close the tap and empty the 3-pint into the barrel.

Fill the 3-pint from the five pint.

Empty the 3-pint into the barrel.

Transfer the 2 pints from the 5-pint to the 3-pint measure.

Fill the 5-pint from the barrel, leaving 1 pint in the barrel.

Fill the 3-pint from the 5-pint, leaving 4 pints in the 5-pint.

Empty 3 on the ground.

Fill the 3-pint from the 5-pint, leaving 1 pint in the 5-pint measure.
Empty the 3-pint.
Transfer 1 pint from barrel to the 3-pint.

Criteria: Time; number of moves required; success/failure.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.44
Decision verifiability	7.16	3.08
Difficulty	5.88	2.38
Goal clarity	5.68	2.91
Goal path multiplicity	2.46	2.50
Intellectual-manipulative requirements	6.85	2.09
Intrinsic interest	3.72	3.05
Operational requirements	4.04	2.22
Population familiarity	3.78	3.21
Solution multiplicity	1.11	1.45

*****

Task 13

Materials: Each group member is given statement of problem: "Post-office is an old parlor favorite among teen-agers and even among some adult groups. The modern equivalent might be represented by a certain Christmas party where many kisses were given and received under the mistletoe. A certain disinterested party kept count of these exchanges.

The party consisted of seven married couples, one widower, three widows, twelve bachelors, and ten maidens. Everybody was found to have kissed everybody else, with the following exceptions: No male kissed a male. No married man kissed a married woman, except his own wife. All of the bachelors kissed all of the maidens twice. The widower did not kiss anybody, and the widows did not kiss each other. How many kisses were exchanged? (Assume that each kiss was returned and the double act counted as one kiss.)"

Instructions: "Discuss the problem among yourselves and arrive at a solution that is acceptable to the group."

Solution: A total of 645 kisses were given. (There were 39 persons present. If everybody kissed everybody else once the number would be 741. If the 12 bachelors kissed the 10 maidens a second time we would have an additional 120, or 861 total. Since no man kissed a married woman except his wife, we deduct 42; no male kissed another male, so another 171 must be deducted; and no widow kissed another widow, deducting 3. Thus 861 - 42 - 171 - 3 = 645.)

Criteria: Time; correct/incorrect.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.32	2.56
Decision verifiability	7.37	0.62
Difficulty	4.65	2.24
Goal clarity	5.55	3.08
Goal path multiplicity	2.50	3.26
Intellectual-manipulative requirements	7.18	1.58
Intrinsic interest	4.77	2.64
Operational requirements	3.35	2.45
Population familiarity	3.72	3.06
Solution multiplicity	0.57	0.56

*****

Task 14

Materials: Paper and pencils. Copy of the following statement of problem:

"A man stopping at a motel ran out of money and would have no more for 23 days. The motel manager would not trust him, but, since the man had a heavy gold chain of 23 links, the manager agreed to accept one link in payment on each successive day and to restore the chain upon receipt of the money. The man was anxious to preserve the chain as intact as possible. How many links was it necessary for him to cut? Show how he was able to pay the manager one link for each successive day and yet cut only this small number of links."

Instructions: "Your task is to discuss this problem among yourselves and arrive at a group solution. Work together cooperatively and try to find a solution that is agreeable to everyone, but unanimity will not be required. When you have a solution that the group is willing to accept, please let me know."

Solution: Payment can be made by cutting only two links - the 4th one and the 11th. This provides two units of 1 link each, one unit of 3 links, one unit of 6 links, and one unit of 12 links. With these units, all values for 1 through 23 can be obtained.

Criteria: Error: difference between smallest possible number (2) and solution; time.

Source: Marquart, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.64
Decision verifiability	7.09	3.24
Difficulty	5.15	2.76
Goal clarity	4.08	3.42

Dimension	Scale value	Q value
Goal path multiplicity	2.54	2.25
Intellectual-manipulative requirements	6.94	1.87
Intrinsic interest	3.94	2.69
Operational requirements	3.56	1.84
Population familiarity	3.28	2.52
Solution multiplicity	0.84	1.72

*****

Task 15

Materials: Paper and pencils.

A balance or lever of the first class, with arms 9½ inches long. Four hooks are placed a 2-inch intervals on the lower side of each arm, beginning at the ends. Hooks are numbered 1, 2, 3, 4, starting at the fulcrum.

Ten weights weighing 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 12 ounces, each having the appropriate number painted on it.

Instructions: "We are interested in studying group problem solving. On each trial, I will hang one of these weights on one of the hooks on this balance. Your task, working as a group, will be to decide which other weight you should hang from which hook on the other side of the fulcrum so that the two are balanced. When you have decided, hang the weight on the hook to see whether you have chosen correctly. Trials will continue until you are able to state the correct principle that is involved."

Solution: Principle: A lever is balanced when the weight times the distance on one side of the fulcrum equals the weight times the distance on the other side of the fulcrum.

Criteria: Number of trials required to discover principle; time required for each decision (mean per decision); number of correct trials.

Source: Peterson, 1932.

Dimension	Scale value	Q value
Cooperation requirements	2.69	2.92
Decision verifiability	6.68	1.95
Difficulty	3.50	2.76
Goal clarity	4.69	3.54
Goal path multiplicity	2.81	2.86
Intellectual-manipulative requirements	4.64	3.24
Intrinsic interest	2.96	2.56
Operational requirements	3.72	2.90
Population familiarity	4.04	2.62
Solution multiplicity	1.15	2.09

*****

Task 16

Materials: Statement of problem:
"A man bought a horse for $60 and sold it for $70. Then he bought it back for $80 and sold it for $90. How much money did he make in the horse business?"

Instructions: "You will be given 8 minutes to discuss this problem. After the group discussion, each person will please write the answer that he believes to be correct on the paper provided and hand it to me."

Solution: $20 (Incorrect answers that seem plausible range from -$10 to +$30, with +$10 being the most frequent, as reported by Maier & Solem.)

Criterion: Percent correct answers

Source: Maier & Solem, 1952 (Cf. Hoffman & Maier, 1961)

Dimension	Scale value	Q value
Cooperation requirements	1.04	1.60
Decision verifiability	7.26	2.40
Difficulty	1.83	3.67
Goal clarity	7.12	2.94
Goal path multiplicity	1.54	2.10
Intellectual-manipulative requirements	7.18	1.86
Intrinsic interest	3.28	3.04
Operational requirements	1.68	2.57
Population familiarity	6.50	2.19
Solution multiplicity	0.63	0.62

*****

Task 17

Materials: Paper and pencils. Copy of the following problem statement:
"A man took a bottle containing a pint of wine, filled a glass from it, and emptied the glass of wine into a jug containing a pint of water. Then he filled the glass with the mixture in the jug, and poured it back into the wine bottle. Did he take more wine from the bottle than water from the jug, or more water from the jug than wine from the bottle?"

Instructions: "This is a group situation. Discuss the information you have been given and work together on the task toward a group solution. Arrive at a decision as soon as possible and let me know when a decision acceptable to the group has been reached."

Solution: He did neither. Exactly as much wine was taken from the bottle as water from the jug. (Assume the glass held ¼ pint. After the first manipulation, the bottle held 3/4 pint of wine, the jug ¼ pint of wine and 1 pint water. When the glass was filled from the jug, it held 1 part wine and 4 parts water, or 1/5 pint of wine and 4/5 pint of water. Thus, 4/5 pint of wine was left in the jug, and 4/5 pint of water was added to the bottle of wine.)

Criteria: Time; pass/fail.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.29	2.28
Decision verifiability	7.23	1.64
Difficulty	5.04	2.09
Goal clarity	4.70	4.03
Goal path multiplicity	1.96	2.41
Intellectual-manipulative requirements	7.06	2.08
Intrinsic interest	3.31	3.05
Operational requirements	3.41	2.36
Population familiarity	3.77	2.51
Solution multiplicity	0.70	0.86

*****

Task 18

Materials: A copy of the following statement:
"A man, having imbibed too freely, wandered into a vacant lot and fell into an open pit, 25 feet deep. Each time he took a step (as he tried to climb out) he moved upwards three feet, but slipped back two. How many steps will be required to get out of the pit?"

Instructions: "This is a group task. Discuss the problem among yourselves and arrive at a group solution."

Solution: 23 steps. (On the last step he reaches the top and so does not slide back the usual two feet.)

Criteria: Pass/fail; time.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.71	1.85
Decision verifiability	7.32	0.88
Difficulty	2.41	3.41
Goal clarity	6.83	2.15
Goal path multiplicity	0.98	1.84

Dimension	Scale value	Q value
Intellectual-manipulative requirements	7.33	1.04
Intrinsic interest	3.62	2.39
Operational requirements	2.10	1.64
Population familiarity	5.09	3.11
Solution multiplicity	0.53	0.54

*****

Task 19

Materials: Copy of the following statement:
"A man reported that in his travels over the United States he found a mountain with such strange characteristics that a glass would hold less water on top of the mountain than in the valley below. What mountain has this strange characteristic?"

Instructions: "Your task is to discuss the problem you have been given and arrive at a group decision regarding the question posed in the problem statement."

Solution: Any mountain one cares to name. (The surface of any liquid is always spherical, and the greater any sphere is the less its convexity. Therefore, the top of any vessel will form the base of a greater sphere at the top of a mountain that at the bottom. This sphere, being greater, must be more convex; in other words, the spherical surface of the water must be less above the brim of the glass, and so will hold less water at the top of a mountain than at the bottom.)

Criteria: Time; pass/fail.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.61	1.84
Decision verifiability	6.62	2.18
Difficulty	3.17	4.42
Goal clarity	4.25	4.65
Goal path multiplicity	2.28	3.32
Intellectual-manipulative requirements	7.42	0.60
Intrinsic interest	2.78	3.36
Operational requirements	1.94	2.67
Population familiarity	2.32	3.10
Solution multiplicity	2.08	5.30

*****

Task 20

Materials: Copy of problem statement:
"A lady was once seated in the family room watching TV when her son entered the room. Upon receiving the parental command, "Go away, my son, and do not disturb me!", the son replied, "I am your son, but you are not my mother, and until you have shown me how this can be, I shall not leave.
How do you explain the son's statement?

Instructions: "Your task, working as a group, is to arrive at a solution to the assigned problem."

Solution: The boy's father was also in the room; the parental command came from him.

Criteria: Time; success/failure; number of communications.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.50	2.09
Decision verifiability	5.90	3.04
Difficulty	3.06	3.71
Goal clarity	3.75	5.25
Goal path multiplicity	1.75	3.27
Intellectual-manipulative requirements	7.43	0.56
Intrinsic interest	4.36	3.17
Operational requirements	1.68	2.01
Population familiarity	3.70	3.00
Solution multiplicity	0.84	1.60

*****

Task 21

Materials: 11 pennies (or tokens). Coins are placed on table before group members, who are instructed as follows:

Instructions: "Your task, working as a group, is to determine how it is possible to remove five coins from the 11 on the table before you, add four coins, and leave nine coins."

Solution: Remove five coins from the 11 on the table, then add four to those that were removed, making 9 left - in the group of removed coins.

Criteria: Time; correct/incorrect.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.61	2.16
Decision verifiability	7.30	1.48
Difficulty	2.58	2.86
Goal clarity	4.69	3.63
Goal path multiplicity	1.06	2.08
Intellectual-manipulative requirements	4.61	2.72
Intrinsic interest	3.35	2.38
Operational requirements	1.54	2.00
Population familiarity	3.77	2.79
Solution multiplicity	0.64	0.66

*****

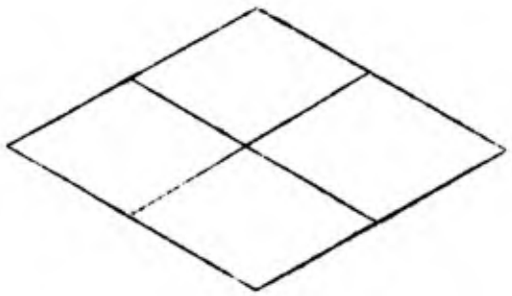
Task 22

Materials: Paper and pencils. Copy of the following statement of the problem:

"A certain man noticed that his bedroom had a square window that measured (on the inside) one foot every way, and was divided into four sections measuring 6 inches on every side. (He ignored the width of the bars separating sections.) Then he called in a carpenter and asked him to put in another window also measuring one foot on each side, but divided into 8 sections whose sides are all equal. How can this be done?

Instructions: "This is a group task. You may discuss the problem among yourselves and attack the problem in any way that you see fit. The problem will be solved when you have a solution that is acceptable to the group."

Solution:



Criteria: Time; pass/fail

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.15	2.65
Decision verifiability	7.32	1.14
Difficulty	4.59	2.94
Goal clarity	3.62	3.47
Goal path multiplicity	2.23	2.60

Dimension	Scale value	Q value
Intellectual-manipulative requirements	5.44	3.39
Intrinsic interest	2.61	2.71
Operational requirements	3.42	3.44
Population familiarity	3.59	3.19
Solution multiplicity	0.66	0.66

Arithmetic Problems

Task 23

Materials: Paper and pencils; one copy for each S of the following instructions.

Instructions: "You are a five man team whose job is to manufacture a product, the completion of which requires the operation of five machines. In the past, you have rotated positions to avoid boredom, but each man has spent most of the time operating the machine that he prefers. John prefers machine 3, Steve machine 2, Walt machine 4, Robert machine 1, and Dennis machine 5.

The Methods man has been around checking the time each man requires to complete the operation on one product when he is operating each of the five machines. He has come up with the following results:

	Machines 1	2	3	4	5
John	3 min.	3 min.	4 min.	$3\frac{1}{2}$ min.	$4\frac{1}{2}$ min.
Steve	3 min.	2 min.	5 min.	$2\frac{1}{2}$ min.	$3\frac{1}{2}$ min.
Walt	1 min.	2 min.	5 min.	2 min.	$1\frac{1}{2}$ min.
Robert	4 min.	1 min.	3 min.	$3\frac{1}{2}$ min.	3 min.
Dennis	5 min.	3 min.	2 min.	5 min.	3 min.

Your foreman noticed that when each man runs the machine that he most prefers, the total time spent on each product is 16 minutes. It seems to him that a different method of operation would result in substantial savings. He believes in letting his workers make their own decision, in so far as possible, and has asked that you consider the problem and try to come up with a plan that will be more efficient than the present mode of operation.

Your task now is to examine the data provided by the Methods man and decide which person should operate which machine. When you have reached a decision, please write your plan out in detail on the paper provided." (Note: Each S is given one of the names listed below.)

Solution:

Walt	machine 5 -	$1\frac{1}{2}$ min.
Steve	machine 4 -	$2\frac{1}{2}$ min.
Dennis	machine 3 -	2 min.
Robert	machine 2 -	1 min.
John	machine 1 -	3 min.
	Total time	10 min.

Criteria: Amount of time for total operation according to the plan decided upon (the more time, the less effective the plan); time required to reach a decision.

Source: Maier, 1953.

Dimension	Scale value	C value
Cooperation requirements	3.05	2.90
Decision verifiability	6.72	1.92
Difficulty	4.19	3.26
Goal clarity	4.35	3.88
Goal path multiplicity	2.94	2.70
Intellectual-manipulative requirements	6.38	2.36
Intrinsic interest	3.12	2.20
Operational requirements	3.39	2.63
Population familiarity	4.44	3.22
Solution multiplicity	0.91	2.68

*****

Task 24

Materials: Paper and pencils, One copy of each of the following problem statement for each group member:

"You are asked to give time of arrival at Town 4 of a plane which left Town 1 at 12;00 noon. You know the towns at which the plane must land, distance between towns, duration of stops and speed of the plane. What time does the plane land at Town 4?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The plane stops at Town 2 for 1 hour.
Distance from Town 2 to Town 3 is 200 miles
The plane must land at Town 2.
The plane must land at Town 3.
The speed of the plane is 100 miles per hour.
Distance from Town 1 to Town 2 is 100 miles.
Distance from Town 3 to Town 4 is 100 miles.
The plane stops at Town 3 for 1 hour.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therfore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: 6:00 p.m.

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Shaw, 1954a.

Dimension	Scale value	Q value
Cooperation requirements	6.25	2.00
Decision verifiability	7.34	0.66
Difficulty	4.43	2.67
Goal clarity	5.28	3.48
Goal path multiplicity	2.95	2.88
Intellectual-manipulative requirements	6.32	2.26
Intrinsic interest	3.04	2.21
Operational requirements	3.66	2.29
Population familiarity	4.46	2.33
Solution multiplicity	0.57	0.56

*****

Task 25

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"You want to determine how many men to hire in order to complete a certain building in 10 days. There are four jobs to be done: paint inside walls, lay floors, install plumbing fixtures and install electrical outlets. What is the minimum number of workers that you must hire?"

One copy of each of the following items: (Items are randomly distributed among group members.)

Each painter can paint one wall per day.
There are 20 walls to be painted.
Each plumber can install 5 fixtures per day.
There are 100 plumbing fixtures to be installed.
Each electrician can install 20 outlets per day.
There are 400 electrical outlets to be installed.
Each carpenter can lay one floor in 2 days.
There are 5 floors to be laid.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: 7

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Shaw & Rothschild, 1956.

Dimension	Scale value	Q value
Cooperation requirements	6.25	1.92
Decision verifiability	7.30	1.10
Difficulty	4.46	2.64
Goal clarity	4.90	3.55
Goal path multiplicity	2.95	2.98
Intellectual-manipulative requirements	6.18	2.31
Intrinsic interest	3.04	2.20
Operational requirements	3.77	2.56
Population familiarity	4.77	2.54
Solution multiplicity	0.56	0.56

*****

Task 26

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"Your group represents an industrial organization which needs to purchase 50 trucks. You are considering four different makes: Fonds, Chats, Stuarts, and Plumes. The organization wants to buy the one which will give maximum service per unit cost. Which make do you purchase?"

One copy of each of the following items: (Items are randomly distributed among group members.)

Fonds cost $3000 each.
The average life of a Fond is 3 years.
Chats cost $3500 each.
The average life of a Chat is 3½ years.
Stuarts cost $4000 each.
The average life of a Stuart is 3 years.
Plumes cost $3500 each.
The average life of a Plume is 4 years.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items in information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution of someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: Plumes.

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Shaw & Rothschild, 1956.

Dimension	Scale value	Q value
Cooperation requirements	6.18	1.87
Decision verifiability	7.30	1.30
Difficulty	4.27	2.96
Goal clarity	5.21	3.44
Goal path multiplicity	3.06	2.77
Intellectual-manipulative requirements	6.41	2.29
Intrinsic interest	3.25	2.02
Operational requirements	3.54	2.36
Population familiarity	5.06	3.43
Solution multiplicity	0.54	0.56

*****

Task 27

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"You are a staff group for a manufacturing company. You must decide which of four types of appliances to manufacture in 1956. The types of appliances are: toasters, waffle irons, mixers, and radios. Select the one which will yield the greatest total net profit. Which type of appliance do you manufacture?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The company can make 100 toasters per day.
The company makes $1 net profit on each toaster.
The company can make 75 waffle irons per day.
The company makes $2 net profit on each waffle iron.
The company can make 50 mixers per day.
The company makes $3 net profit on each mixer.
The company can make 50 radios per day.
The company makes $4 net profit on each radio.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: Radio

Criteria: Average of individual scores; errors (number of incorrect solutions submitted).

Source: Shaw & Rothschild, 1956.

Dimension	Scale value	Q value
Cooperation requirements	6.32	1.88
Decision verifiability	7.28	1.48
Difficulty	4.25	3.35
Goal clarity	5.07	3.54
Goal path multiplicity	2.94	2.77
Intellectual-manipulative requirements	6.21	2.34
Intrinsic interest	3.35	2.20
Operational requirements	3.61	2.46
Population familiarity	4.94	3.02
Solution multiplicity	0.56	0.56

*****

Task 28

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"Your group must raise money to buy a number of items for prizes for carnival games. You must buy four different items: dolls, flags, canes, and ashtrays. How much money must the group raise to pay for all items?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The group needs 50 dolls.
Dolls cost 20 cents each.
The group needs 75 flags.
Flags cost 10 cents each.
The group needs 100 canes.
Canes cost 15 cents each.
The group needs 100 ashtrays.
Ashtrays cost 10 cents each.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?

Solution: $42.50

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Shaw & Rothschild, 1956

Dimension	Scale value	Q value
Cooperation requirements	6.25	1.92
Decision verifiability	7.36	0.66
Difficulty	4.15	3.29
Goal clarity	5.21	3.60
Goal path multiplicity	2.95	2.81
Intellectual-manipulative requirements	6.35	2.20
Intrinsic interest	3.19	2.37
Operational requirements	3.54	2.70
Population familiarity	5.64	1.14
Solution multiplicity	0.56	0.56

*****

Task 29

Materials: Paper and pencils. One copy of the following problem statement for each group member.

"Eight men have volunteered for a dangerous bombing mission. Four are needed: pilot, co-pilot, navigator and bombadier. You must select four from the 8 volunteers, using number of dependents as the criterion. Which four do you select?"

One copy of each of the following items: (Items are randomly distributed among group members.)

Co-pilot A is married and has three children.
Co-pilot B is married and has one child.
Pilot C is married and has two children.
Pilot D is married and has one child.
Navigator E has no dependents.
Navigator F is married but has no children.
Bombadier G is married but has no children.
Bombadier H has no dependents.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: B, D, E, and H.

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Shaw & Rothschild, 1956.

Dimension	Scale value	Q value
Cooperation requirements	6.12	1.96
Decision verifiability	7.16	1.88
Difficulty	4.06	3.36
Goal clarity	5.36	3.54
Goal path multiplicity	3.31	3.00
Intellectual-manipulative requirements	6.50	2.30
Intrinsic interest	3.58	1.90
Operational requirements	3.15	2.54
Population familiarity	4.61	2.58
Solution multiplicity	0.74	1.76

*****

Task 30

Materials: Paper and pencils. One copy of the following problem statement for each group member.

"A Father is partially supporting his married son while the son is in school. Dependents of the son may be claimed either by the son or by his father for income tax purposes. How many dependents should the father claim in order to save the maximum amount of money for the two families?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The son has four dependents.
$600 may be deducted from taxable income for each dependent.
The father's tax is 40% of his taxable income.
If the son claims only 2 dependents, he must pay $236 tax.
If the son claims 3 dependents, he pays $106 tax.
If the son claims only 1 dependent, he pays $436 tax.
If the son claims 4 dependents, he pays nothing and gets $240 tax return.
If the son claims no dependents, he pays $720 tax.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own

solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: 3

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	6.30	1.98
Decision verifiability	7.30	1.04
Difficulty	4.68	2.12
Goal clarity	4.93	3.42
Goal path multiplicity	3.25	2.54
Intellectual-manipulative requirements	6.50	1.77
Intrinsic interest	3.41	2.50
Operational requirements	3.94	2.89
Population familiarity	4.85	3.26
Solution multiplicity	0.57	0.56

*****

Task 31

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"A moving van is scheduled to leave city A with items to be delivered at Cities B, C, D, & E. There are several routes that might be followed, but the driver wants to pick the shortest one. Of course, he does not want to travel the same road twice, so he plans to visit each city once and only once. What is the shortest route?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The distance from A to B is 200 miles. (direct route)
The distance from A to C is 50 miles. "
The distance from A to D is 200 miles. "
The distance from B to C is 150 miles. "
The distance from B to E is 100 miles. "
The distance from C to D is 200 miles. "
The distance from D to E is 50 miles. "
There is no direct route between A and E, B and D, or C and E.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: ACBED (350 miles)

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	6.30	1.90
Decision verifiability	7.34	0.66
Difficulty	4.32	2.12
Goal clarity	4.70	3.39
Goal path multiplicity	3.50	2.76
Intellectual-manipulative requirements	6.42	2.36
Intrinsic interest	3.12	2.73
Operational requirements	4.12	2.52
Population familiarity	4.83	2.46
Solution multiplicity	0.58	0.60

*****

Task 32

Materials: Paper and pencils. One copy of the following problem statement for each group member.

"You want to paint four rooms in your house: living room, kitchen, dining room, and bedroom. You have some paint and you want to buy as little additional paint as possible to complete the job. How would you distribute the paint among the rooms, and how much additional paint would you need to buy?"

One copy of each of the following items: (Items are randomly distributed among group members.)

The living room requires 4 gallons of paint.
You have 6 gallons of blue paint.
The dining room requires 2 gallons of paint.
You have ½ gallon of brown paint.
The kitchen requires 3 gallons of paint.

You have 1 gallon of green paint.
The bedroom requires 1½ gallons of paint.
You have 2½ gallons of yellow paint.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: LR and DR blue, K yellow, BR green; need ½ gallon yellow and ½ gallon green to complete - or a total of 1 extra gallon.

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	6.27	1.91
Decision verifiability	7.16	2.04
Difficulty	4.50	2.60
Goal clarity	4.78	3.43
Goal path multiplicity	3.28	2.91
Intellectual-manipulative requirements	6.37	2.14
Intrinsic interest	4.35	2.59
Operational requirements	4.06	2.87
Population familiarity	5.05	3.08
Solution multiplicity	0.64	0.66

*****

Task 33

Materials: Paper and pencils. One copy of the following problem statement for each group member:

"On certain days a salesman begins his travels at 6:00 A.M. He visits four cities in the following order: ABCDBCA. What time does he get home?"

One copy of each of the following items: (Items are randomly distributed among group members.)

It is a 1½ hour drive from A to B.
It is a 2½ hour drive from C to D.
It is a 1 hour drive from C to A.
It is a 3 hour drive from B to D.
It is a 2 hour drive from B to C.
He spends 45 minutes at B each time he visits it.
He spends 1 hour at C each time he visits it.
He spends 1½ hours at D each time he visits it.

Instructions: "Your task is to solve the problem you have been given working together as a group. No one of you can solve the problem working alone because no one has all the information needed to solve it. You must, therefore, communicate with each other in order to reach solutions. You may communicate freely among yourselves, but you may not show each other the items of information that you have been given. The object is for every member in the group to learn the answer in the shortest possible time. When you have an answer that you are willing to accept - either your own solution or someone else's - raise your hand and I will collect your solution. The sooner each of you reports a solution, the better will be the group's performance score. Are there any questions?"

Solution: 11:00 P.M.

Criteria: Average of individual time scores; errors (number of incorrect solutions submitted).

Source: Formulated by W. T. Penrod, Jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	6.25	2.00
Decision verifiability	7.32	0.94
Difficulty	4.32	2.97
Goal clarity	4.81	3.54
Goal path multiplicity	2.88	2.74
Intellectual-manipulative requirements	6.39	2.07
Intrinsic interest	2.71	2.79
Operational requirements	3.75	2.69
Population familiarity	4.44	2.85
Solution multiplicity	0.56	0.56

*****

Task 34

Materials: Paper and pencils. A copy of the problem statement for each group member:

"Jim Smith remarked that he had seen a big mackeral and a big pickerel in the shallows of a nearby cove. When pressed for an estimate of their size, he related the following observations:

The body of the pickerel was about twice the length of its tail.

The body of the pickerel was about equal to the length of its head plus the length of the tail of the mackerel.

The body of the mackerel was about as long as the whole pickerel minus the head.

The head of the mackerel was about as long as the tail of the pickerel.

The head of the pickerel was about $\frac{1}{4}$ of the body of the mackerel.

Both fish together were about three feet long.

What was the size of the mackerel?"

Instructions: Your task is to work cooperatively as a group in arriving at an answer to the question posed at the end of the problem statement. Discuss the problem among yourselves and attack the problem in any way you wish. When you have an answer, please let me know."

Solution: 21 inches

Criteria: Time required for solution; error: deviation from true length; unanimity of opinion.

Source: Formulated by W. T. Penrod, jr., especially for this project.

Dimension	Scale value	Q value
Cooperation requirements	2.21	2.91
Decision verifiability	7.34	0.66
Difficulty	4.91	1.84
Goal clarity	5.93	3.41
Goal path multiplicity	2.62	2.37
Intellectual-manipulative requirements	7.09	2.14
Intrinsic interest	3.41	2.61
Operational requirements	3.62	2.10
Population familiarity	4.04	2.53
Solution multiplicity	0.57	0.56

*****

Sorting and Transfer Tasks

Task 35

Materials: Pack of ordinary playing cards with face cards removed. A large cardboard marked off into 15 spaces, each large enough for an ordinary playing card and each labeled as indicated in the diagram below:

Red 3	7	Red 6	4	Black 4
20	Red 15	13	17	Black 19
Black 14	13	30	Black 10	Red 45

Instructions: "Your task, working together as a group, is to sort these cards as quickly as possible into 15 groups as indicated on this chart. Each group is to have the cards in it adding to the value indicated here (point), and all the cards of a group are to be of the color indicated here (point). Where no color in indicated the cards may be mixed, but in every case the value of the cards in a group must be shown. Your score will be the number of groups correctly assembled when time is called or upon time taken if you complete the task before time is called."

Solution: Sorting as shown by chart.

Criteria: Number of groups correctly assembled; time required.

Source: Cattell, Saunders, & Stice, 1953.

Dimension	Scale value	Q value
Cooperation requirements	3.25	2.97
Decision verifiability	7.12	2.18
Difficulty	4.17	3.00
Goal clarity	4.93	3.60
Goal path multiplicity	3.36	3.17
Intellectual-manipulative requirements	3.06	2.40
Intrinsic interest	3.05	3.36
Operational requirements	3.23	3.00
Population familiarity	2.59	2.61
Solution multiplicity	2.44	2.92

*****

Task 36

Materials: Paper and pencils. Copy of problem statement: "A milkman has a 14 quart can full of milk. He wishes to divide the milk into two equal portions. In addition to the 14 quart measure he has a 5 quart measure and a 9 quart measure. How does he make the division without any waste, using the three measures only, and not guessing at the amounts?

Instructions: "This is a group task. Work on the problem cooperatively and try to arrive at a group solution. When you have a solution that is acceptable to the group, please let me know."

Solution: Numbers refer to the measures that the milkman has available. Each step represents a single transfer of milk from one measure to another.

Transfer from-to		Amounts left in 5	9	14
14	9	0	9	5
9	5	5	4	5
5	14	0	4	10
9	5	4	0	10
14	9	4	9	1
9	5	5	8	1
5	14	0	8	6
9	5	5	3	6
5	14	0	3	11
9	5	3	0	11
14	9	3	9	2
9	5	5	7	2
5	14	0	7	7

Criteria: Number of transfers; time.

Source: Marquart, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.61	2.23
Decision verifiability	6.86	1.86
Difficulty	5.83	2.10
Goal clarity	5.25	4.04
Goal path multiplicity	3.06	2.89
Intellectual-manipulative requirements	6.42	2.76
Intrinsic interest	3.04	2.84
Operational requirements	4.04	1.98
Population familiarity	3.50	2.80
Solution multiplicity	1.58	2.83

*****

Task 37

Materials: Six disks labeled H1, H2, H3, W1, W2, and W3, respectively. A large card with a diagram of a river. Paper and pencils.

Instructions: "The materials for this problem are the six disks you have been given. On the A-side of a river are three wives (W1, W2, W3) and their husbands (H1, H2, H3). All of the men but none of the women can row. Get them across to the B-side of the river by means of a boat carrying only three at one time. No man will allow his wife to be in the presence of another man unless he is also there.

This is a group task. Work together to solve the problem as accurately and as quickly as possible. When you have finished, write out your solution and hand it to me."

Solution:
H1,W1 cross over
H1 returns alone
H1, H2, W2 cross
H1, H2 return
H1, H2, H3 cross
H3 returns
H3, W3 cross

Criteria: Time; number of crossings

Source: Shaw, Marjorie E., 1932. (Cf. Marquart, 1955)

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.20
Decision verifiability	7.06	2.96
Difficulty	4.50	2.97
Goal clarity	5.50	2.84
Goal path multiplicity	2.50	2.54
Intellectual-manipulative requirements	5.35	2.52
Intrinsic interest	4.05	2.23
Operational requirements	3.44	1.79
Population familiarity	3.69	3.49
Solution multiplicity	1.37	2.28

*****

Task 38

Materials: Paper and pencils. A large card with a diagram of a river. Six disks labelled M1, M2, M3, C1, C2, and RC, respectively.

Instructions: "Three missionaries (represented by the disks labelled M1, M2, M3) and three cannibals (represented by the disks labelled C1, C2, and RC) are on the A-side of the river on your diagram. Your task is to get them across to the B-side of the river by means of a boat which holds only two persons at one time. All of the missionaries and one cannibal (RC) can row. Never, under any circumstances or at any time, may the missionaries be outnumbered by the cannibals. (Except, of course, when there are no missionaries present.) This is a group task. Work together cooperatively to solve the problem as accurately and as quickly as possible. When you have finished, write out your solution and hand it to me."

Solution:

1. M1 and C1 cross
2. M1 returns
3. RC and C2 cross
4. RC returns
5. M1 and M2 cross
6. M1 and C1 return
7. RC and M1 cross
8. M1 and C2 return
9. M1 and M3 cross
10. RC returns
11. RC and C1 cross
12. RC returns
13. RC and C2 cross

Criteria: Number of crossings required; time; correct/incorrect.

Source: Shaw, Marjorie E., 1932. (Cf. Marquart, 1955)

Dimension	Scale value	Q value
Cooperation requirements	2.35	2.37
Decision verifiability	7.02	3.10
Difficulty	5.32	2.90
Goal clarity	5.54	2.78
Goal path multiplicity	2.42	2.78
Intellectual-manipulative requirements	5.61	2.55
Intrinsic interest	4.50	2.33
Operational requirements	3.50	1.81
Population familiarity	3.81	3.38
Solution multiplicity	1.21	1.35

*****

Task 39

Materials: A collection of buttons having the following characteristics:

Four different colors
Four different sizes
Four different shapes

(In other words, buttons may be classified into four categories on each of the characteristics listed above. Buttons are selected so that no two categories will result in the same distribution of buttons.)

Instructions: "This is a reasoning task. You are to work on this task as a group. The envelope before you contains a number of buttons. There are just four kinds of buttons. Your task is to sort the buttons into groups representing the four kinds of buttons. Are there any questions?"

Solutions: Classifications vary in frequency in the following order:

Color (most frequent)
Size
Shape

Criteria: Time required for an acceptable classification; uniqueness of classification (Shape most unique, etc.)

Source: Shaw & Gilchrist, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.50	2.36
Decision verifiability	4.50	3.92
Difficulty	1.82	2.04
Goal clarity	4.42	3.43
Goal path multiplicity	3.53	2.26
Intellectual-manipulative requirements	4.07	3.11
Intrinsic interest	2.90	3.22
Operational requirements	1.96	2.41
Population familiarity	4.38	3.82
Solution multiplicity	3.46	2.00

*****

Task 40

Materials: A square cardboard (about 2' x 2') divided into 16 equal sized squares.

Sixteen cardboard squares about the size of the small squares on the board. On each card one of the following words is written: thirst, drinking, liquid, fountain, hunger, eating, food, restaurant, need money, working, job, industry, sex desire, sex act, woman, marriage.

Instructions: "This is a reasoning task. You are to work together on it as a group. The envelopes before you contain cards upon which a number of words have been written. At the go signal, remove the cards from the envelope and do with them whatever you think you should. The board with the 16 squares may be used if you so desire. Are there any questions?"

Solution: Cards should be arranged in the following manner:

thirst	hunger	sex desire	need money
fountain	restaurant	marriage	industry
liquid	food	woman	job
drinking	eating	sex act	working

This is a double classification based upon categories of motivation (lst row), institution where motive may be satisfied (second row), object of need satisfaction (third row), and act of satisfying the motive (fourth row), and upon the relations among these categories (e.g., thirst-fountain-liquid-drinking are related to a greater extent than thirst-restaurant-woman-drinking). The order or rows and columns is of no consequence as long as the above relations are maintained.

Criteria: Number of words correctly placed; time.

Source: Gilchrist, 1952.

Dimension	Scale value	Q value
Cooperation requirements	3.21	2.83
Decision verifiability	4.62	3.31
Difficulty	3.64	2.92
Goal clarity	1.59	2.85
Goal path multiplicity	4.15	2.98
Intellectual-manipulative requirements	5.12	2.37
Intrinsic interest	4.85	2.62
Operational requirements	4.35	3.57
Population familiarity	2.79	2.79
Solution multiplicity	2.41	2.61

*****

Task 41

Materials: Sixteen cards with numbers 1 through 16 printed on them. Cards are arranged as shown below:

1	15	5	12
8	10	4	9
11	6	16	2
14	3	13	7

Instructions: "In as few a moves as possible, rearrange the cards so that the four rows, the four columns, and the two long diagonals each add up to 34."

Solution:

1	11	6	16
8	14	3	9
15	5	12	2
10	4	13	7

or any other arrangement that will meet the conditions.

Criteria: Number of moves; time.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.07	2.64
Decision verifiability	7.06	3.36
Difficulty	4.81	2.97
Goal clarity	6.06	2.53
Goal path multiplicity	4.04	2.47
Intellectual-manipulative requirements	4.14	2.26
Intrinsic interest	2.64	3.27
Operational requirements	3.27	2.36
Population familiarity	2.61	2.76
Solution multiplicity	3.95	2.29

*****

Task 42

Materials: Nine cards labelled with numbers 1 through 9. Cards are arranged in groups:

7 28 196 34 5

Instructions: "If we multiply the first two numbers (7 x 28) it happens that the answer is the middle number (196). But if we multiply the pair at the other end (5 x 34) the answer will not be the middle number (196).

Your task, working as a group, is to rearrange the nine cards in as few moves as possible so that each of the end groups when multiplied will equal the number in the middle. (Groups must contain same number of cards as before; i.e., 1 card, 2 cards, 3 cards, 2 cards, and 1 card, in that order.)"

Solutions:

2	78	156	39	4	(Requires moving 5 cards)
4	39	156	78	2	(Requires moving 7 cards)
3	58	174	29	6	(Requires moving 7 cards)
6	29	174	58	3	(Requires moving 7 cards)

Criteria: Time required; number of moves required for solution; success/failure in alloted time.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.44	2.36
Decision verifiability	7.23	2.04
Difficulty	5.37	2.45
Goal clarity	5.06	3.91
Goal path multiplicity	3.50	2.48
Intellectual-manipulative requirements	4.32	1.85
Intrinsic interest	2.23	2.52
Operational requirements	3.47	2.10
Population familiarity	2.81	2.65
Solution multiplicity	2.50	2.26

*****

Task 43

Materials: Six black cardboard disks numbered from 1 through 6, and 6 white disks numbered fkom 7 through 12. A ring, about 3 inches wide, drawn on a work table (or a portable board) and divided into 13 sections, or compartments. Disks are placed in compartments in numberical order with an empty compartment between disks No. 6 and 7.

Instructions: "The white disks may be moved in one direction and the black disks in the opposite direction. They may be moved in any order, one step at a time, or by jumping over one of the opposite color to an empty space beyond. In as few moves as possible, change disks so that white disks are where the black disks originally were, and vice versa. The only restrictions are that Disk No. 1 must be where Disk No. 12 was originally, and vice versa.

Your task, working as a group, is to determine how many moves are necessary to complete the transfer."

Solution: Minimum number of moves is 118.
(If white disks move clockwise and black disks counterclockwise, the moves are:
6, 7, 8, 6, 5, 4, 7, 8, 9, 10, 6, 5, 4, 3, 2, 7, 8, 9, 10, 11, (6, 5, 4, 3, 2, 1), 6, 5, 4, 3, 2, 12, (7, 8, 9, 10, 11, 12), 7, 8, 9, 10, 11, 1, 6, 5, 4, 3, 2, 12, 7, 8, 9, 10, 11, 6, 5, 4, 3, 2, 8, 9, 10, 11, 4, 3, 2, 10, 11, 2. Numbers in parentheses are repeated five times.)

Criteria: Number of moves; time.

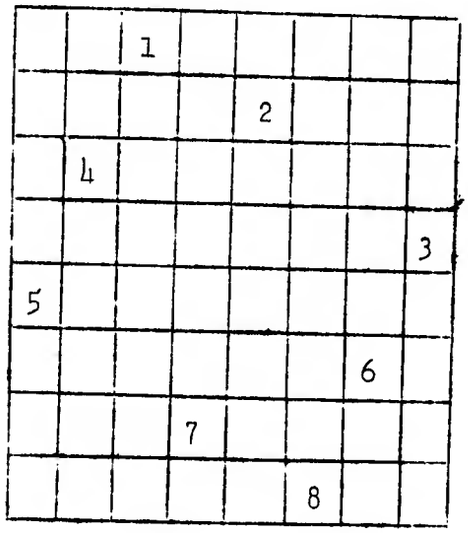
Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.50	2.51
Decision verifiability	6.42	2.81
Difficulty	5.36	3.10
Goal clarity	3.21	3.40
Goal path multiplicity	3.50	3.76
Intellectual-manipulative requirements	3.78	2.35
Intrinsic interest	2.61	2.46
Operational requirements	3.64	1.73
Population familiarity	1.95	2.08
Solution multiplicity	2.36	3.33

*****

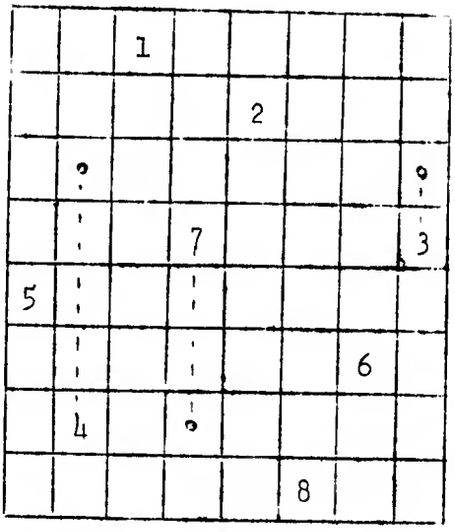
Task 44

Materials: A "checkerboard" marked off so that there are 64 squares, eight on each side. Eight tokens placed on the board as shown below:



Instructions: "Considering only the diagonals you will notice that no two tokens are anywhere in a line. Your task, as a group, is to move three of the tokens from their present position to a square that is now unoccupied, so that in their new relative positions still no two tokens shall be in a line."

Solution:



Criteria: Time; number of correct moves.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	1.86	2.87
Decision verifiability	7.30	1.18
Difficulty	3.42	2.86
Goal clarity	5.69	2.66
Goal path multiplicity	2.36	3.09
Intellectual-manipulative requirements	3.07	2.88
Intrinsic interest	3.08	3.33
Operational requirements	1.96	2.53
Population familiarity	2.35	2.38
Solution multiplicity	1.44	2.06

*****

Task 45

Materials: Twelve cardboard squares and 12 matches (or other tokens). Arrange cardboard squares so that they form a circle on a work table. Put one match on each square.

Instructions: "You are to work on this task as a group. Start at any square and always move in one direction around the circle. Take one match, pass it over two other matches, and place it on the next square. Again, take one match, move it over two other matches, and place it on the next square. Continue in this manner until you have two matches on each of 6 squares, with the other squares empty. Only six matches are to be moved. Do this in as few trips around the circle as possible."

Solution: If squares are numbered 1 through 12, and "1 to 4" means take the match from Square No. 1 and move it to Square No. 4, then: 1 to 4, 5 to 8, 9 to 12, 3 to 6, 7 to 10, 11 to 2

or

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

Requires 3 revolutions. (It can also be solved in 4 revolutions.)

Criteria: Time; number of revolutions.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.85	2.65
Decision verifiability	6.19	2.44
Difficulty	4.17	3.23
Goal clarity	3.92	3.14
Goal path multiplicity	3.31	2.49
Intellectual-manipulative requirements	2.97	2.44
Intrinsic interest	2.75	3.33
Operational requirements	3.53	1.75
Population familiarity	2.04	1.96
Solution multiplicity	2.62	1.33

*****

Task 46

Materials: Sixteen cards numbered from 0 to 15. Arrange cards as shown below:

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Instructions: "You are to work on this task as a group. In as few moves as possible, rearrange the cards so that the four rows, the four columns, and the two main diagonals each add up to 30."

Solution:

0	14	13	3*	Minimum # moves is 10.
11	5*	6*	8	The numbers with asterisks
7	9*	10*	4	are not moved, although
12	2	1	15*	they do not occupy exactly

the same position as before relative to other positions in the square.

Note: There are other solutions, but all require more than 10 moves.

Criteria: Number of moves; time.

Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.19	3.06
Decision verifiability	6.94	1.87
Difficulty	4.72	3.31
Goal clarity	6.05	2.86
Goal path multiplicity	3.75	3.01
Intellectual-manipulative requirements	4.06	2.59
Intrinsic interest	2.65	3.07
Operational requirements	3.18	2.04
Population familiarity	2.44	2.85
Solution multiplicity	2.64	3.12

*****

Word and Sentence Construction Tasks

Task 47

Materials: A card having the secondary printed on it. Paper and pencils.

Instructions: "This is a group task. You will be allowed 10 minutes to form as many words as possible using only the letters appearing in the word secondary. Each letter may be used only once in each word formed. Singular and plural do not count as separate words. Proper names and slang are not permitted."

Solution: Variable

Criteria: Number of words formed in 10-minute period.

Source: Watson, 1928.

Dimension	Scale value	Q value
Cooperation requirements	1.82	1.95
Decision verifiability	5.50	4.35
Difficulty	1.10	2.35
Goal clarity	7.18	2.28
Goal path multiplicity	5.94	3.39
Intellectual-manipulative requirements	6.37	1.79
Intrinsic interest	4.39	2.89
Operational requirements	1.88	2.04
Population familiarity	5.19	3.76
Solution multiplicity	6.09	1.69

*****

Task 48

Materials: A card having the word neurotics printed on it. Paper and pencils.

Instructions: "This is a group task. You will be allowed 10 minutes to form as many words as possible using only the letters appearing in the word neurotics. Each letter may be used only once in each word formed. Singular and plural do not count as separate words. Proper names and slang are not permitted."

Solution: Variable

Criteria: Number of words formed in 10-minute period.

Source: Watson, 1928.

Dimension	Scale value	Q value
Cooperation requirements	1.82	1.95
Decision verifiability	5.50	4.33
Difficulty	1.08	2.45
Goal clarity	7.18	2.28
Goal path multiplicity	5.94	3.36
Intellectual-manipulative requirements	6.41	1.76
Intrinsic interest	4.43	2.63
Operational requirements	2.04	2.27
Population familiarity	5.19	3.76
Solution multiplicity	6.10	1.75

*****

Task 49

Materials: A card having the word courtesan printed on it. Paper and pencils.

Instructions: "This is a group task. You will be allowed 10 minutes to form as many words as possible using only the letters appearing in the word courtesan. Each letter may be used only once in each word formed. Singular and plural do not count as separate words. Proper names and slang are not permitted."

Solution: Variable.

Criteria: Number of words formed in 10-minute period.

Source: Watson, 1928.

Dimension	Scale value	Q value
Cooperation requirements	1.82	2.04
Decision verifiability	5.42	4.32
Difficulty	1.25	2.44
Goal clarity	7.16	2.54
Goal path multiplicity	5.94	3.45
Intellectual-manipulative requirements	6.37	1.79
Intrinsic interest	4.46	2.87
Operational requirements	1.95	2.27
Population familiarity	5.07	3.57
Solution multiplicity	6.09	1.71

*****

Task 50

Materials: Paper and pencils.

Instructions: "Your task is to write as many meaningful sentences as possible which contain the words to, too, and two. Each sentence must be grammatically correct and must contain all three words. This is a group task. Your score will be the number of acceptable sentences produced in the 15 minutes allotted to this task."

Solution: Variable

Criteria: Number of acceptable sentences produced by the group.

Source: Blake, Mouton, & Fruchter, 1954.

Dimension	Scale value	Q value
Cooperation requirements	2.04	1.93
Decision verifiability	3.79	3.50
Difficulty	1.83	3.67
Goal clarity	7.16	2.62
Goal path multiplicity	6.18	1.98
Intellectual-manipulative requirements	6.04	2.24
Intrinsic interest	3.28	3.65
Operational requirements	2.41	2.95
Population familiarity	5.42	3.25
Solution multiplicity	6.36	1.42

*****

Task 51

Materials: The sentences to be reconstructed are:

1. The picture we saw was painted by an old woman who had been taught how to mix the colors by one of the native artists.
2. The boy on the white bicycle was seen riding down Eighth Avenue at about four o'clock in the afternoon by an old lady called Mary.
3. The local committee for civic improvement net in Town Hall on Saturday afternoon to discuss plans for raising money to build a proposed public library.

For each sentence, each word is typed on a separate card and the cards placed in an envelope.

Instructions: "This is a group problem solving situation. Each of the envelopes you have been given contains a number of cards, each having one word typed on it. Your task is to sort each set of cards so that the words form a meaningful sentence. You may work on the sentences in any order that you wish, but all members of the group must be working on the same sentence at any given time. The object is to complete all three sentences in the shortest possible time."

Solution: Reproduction of sentences listed above.

Criteria: Time; number of sentences correctly reproduced.

Source: Heise & Miller, 1951.

Dimension	Scale value	Q value
Cooperation requirements	3.95	3.10
Decision verifiability	6.32	2.25
Difficulty	4.93	2.77
Goal clarity	6.23	3.61
Goal path multiplicity	3.25	2.24
Intellectual-manipulative requirements	5.58	2.72
Intrinsic interest	3.08	3.21
Operational requirements	3.82	2.38
Population familiarity	2.17	2.85
Solution multiplicity	1.04	1.58

*****

Discussion Tasks

Task 52

Materials: Pencils. Several copies (Number of Ss plus 1) of the following problem sheet:

Problem: How can a person of average ability achieve fame and immortality though he does not possess any particular talents?

Write down the solutions that you think of:

1. _____
2. _____
3. _____

.
.
.

25. _____

One copy for each S of the following instructions.

Instructions: "You have been asked to participate in an experiment on group creativity. The statement of the problem is shown on the top of your problem sheet. The procedure is as follows:

Step 1: Write down as many "solutions" to the problem as you can think of in five minutes. The more different solutions you write, the higher will be your score. Each group member will work independently in this part of the experiment.

Step 2: Each member should read his solutions to the group. Then, working as a group, you must write as many solutions as you can that have not been proposed by any of the group members. For this purpose you have been given an additional problem sheet. Only solutions that did not occur on the individual sheets should be

included on this group sheet. Modifications of two solutions are not acceptable. If a member suggests a solution that has already appeared on an individual sheet, this solution should not be entered on the group sheet. Again, the more different solutions the higher the score of your group. You will have five minutes to work on this problem as a group."

Solution: Variable

Criteria: Number of group solutions (Step 2); total number of solutions (Step 1 and Step 2); quality of group solutions (Step 2); overall quality of solutions (Steps 1 and 2).

Source: H. C. Triandis (personal communication from J. E. McGrath).

Dimension	Scale value	Q value
Cooperation requirements	3.92	3.09
Decision verifiability	2.05	2.44
Difficulty	3.42	3.40
Goal clarity	4.31	3.59
Goal path multiplicity	6.50	1.87
Intellectual-manipulative requirements	6.46	1.92
Intrinsic interest	5.11	2.56
Operational requirements	5.31	3.76
Population familiarity	4.42	3.51
Solution multiplicity	7.06	1.78

*****

Task 53

Materials: Pencils. One sheet of paper for each S with problem statement, "During the years previous to the Chinese-Japanese war, 2,500 Japanese soldiers died yearly in military maneuvers which were purposely designed to be hard and dangerous in order to approach war conditions. In the war that followed, the Japanese had eleven times fewer casualities than the Chinese. After the war, Japanese military authorities, referring to these facts and to an alleged saving of 3,000,000 lives, proposed an even harder and more dangerous military training." This sheet should also provide spaces for 10 pro and 10 con arguments.

One sheet of paper with the above material to be used for group arguments.

One copy of the following instructions for each S:

Instructions: "In the following task you will be given a controversial theme. Consider the theme carefully and then indicate a "yes" or "no" position. You then must give as many consistent pro and contra arguments for the theme as you can think of.

The problem has military, political, social, moral, and psychological aspects. Formulate briefly as many arguments as you can. Each numbered line is for a single argument. The number and quality of the arguments produced will serve as a basis for the evaluation of your performance. Arguments must be relevant to the outlined problem.

You have a total of 10 minutes to construct all your arguments, both pro and con.

Step 1: For half of this time (5 minutes) each of you has to work alone, and produce individually as many arguments as you can.

Step 2: For the second 5 minutes the group will work together to produce more new solutions. For this purpose you will be given a separate Group Sheet. Only arguments which did not occur on the individual sheets should be included on this Group Sheet."

Solution: Variable.

Criteria: Number of arguments produced as a group (last 5 minutes); quality of arguments produced as a group (last 5 minutes); total number of arguments produced; and overall quality of arguments produced.

Source: F. E. Fiedler & L. Szalay (personal communication from J. E. McGrath)

Dimension	Scale value	Q value
Cooperation requirements	4.28	2.74
Decision verifiability	1.50	1.85
Difficulty	5.19	3.93
Goal clarity	4.32	3.47
Goal path multiplicity	7.06	2.34
Intellectual-manipulative requirements	7.02	2.54
Intrinsic interest	5.23	2.09
Operational requirements	5.50	2.51
Population familiarity	4.07	2.95
Solution multiplicity	7.36	0.66

*****

Task 54

Materials: Paper and pencils. Copies (one for each S) of the following problem statement and instructions:

Instructions: "The Supreme Court of the United States has ruled that legislation requiring the reading of the Bible in public schools is unconstitutional. This decision has generated considerable controversy, even among persons of strong religious persuasion. Those supporting the decision do so largely on the basis of separation of church and state, and the constitutional provision of freedom of worship. These persons argue that reading the Bible in schools

forces exposure of all sects to essentially protestant teachings. Those opposed to the decision argue that it weakens the moral foundations of the schools and indeed the country. Mere reading of the Bible, they say, does not constitute teaching religious beliefs."

You are a committee formed to consider the question of use of the Bible in public schools, as representatives of various religious groups. Your task is to discuss this problem and develop a set of recommendations to be adopted as the official policy of the combined religious groups you represent.

You have 25 minutes to discuss and decide on your recommendations, and five more minutes to record them on the paper provided for this purpose. The recommendations must be adopted unanimously by all members of the committee."

Solution: Variable.

Criterion: Judged quality of the set of recommendations produced by the group.

Source: J. E. McGrath, personal communication.

Dimension	Scale value	Q value
Cooperation requirements	4.94	2.41
Decision verifiability	0.79	1.58
Difficulty	4.94	3.71
Goal clarity	4.28	3.67
Goal path multiplicity	7.23	1.82
Intellectual-manipulative requirements	7.18	1.58
Intrinsic interest	5.56	2.85
Operational requirements	5.45	2.62
Population familiarity	5.69	2.67
Solution multiplicity	7.21	1.46

*****

Task 55

Materials: Paper and pencils. Copies (one for each S) of the following problem statement and instructions.

Instructions: "The recent television scandals (the so-called "rigged" quiz shows and "payola" practices) have resulted in proposed legislation to increase the power of the Federal Communication Commission (FCC) to control television programming. The aim of the legislation is to improve the educational and moral quality of material offered on TV, with specific emphasis on eliminating violence in children's programs, deceitful practices (like rigged quiz shows) and obscenity. The proposed legislation would permit the FCC to refuse or revoke licenses, levy fines, and take other measures against any TV station, network, or producer whose material did not live up to a standard ethical and moral code. Many groups are opposing the legislation on the grounds that such censorship

is a restriction of the right of freedom of speech.

Your task as a committee is to consider and discuss this problem as representatives of your religious foundations; and to develop a set of recommendations to be adopted as the official policy of the combined campus religious organizations.

You have 25 minutes to discuss and decide on your recommendations, and five more minutes to record them on the paper that has been provided. The recommendations must be adopted unanimously by all members of this committee."

Solution: Variable

Criterion: Judged quality of the set of recommendations.

Source: J. E. McGrath, personal communication.

Dimension	Scale value	Q value
Cooperation requirements	4.94	2.52
Decision verifiability	0.84	1.88
Difficulty	5.30	3.37
Goal clarity	4.06	3.97
Goal path multiplicity	7.18	2.04
Intellectual-manipulative requirements	7.18	1.72
Intrinsic interest	5.50	3.53
Operational requirements	5.39	3.00
Population familiarity	5.55	2.80
Solution multiplicity	7.21	1.46

*****

Task 56

Materials: Paper and pencils. A copy of the following problem statement and instructions for each S.

Instructions: "The 'Bolte' Commission recently proposed to Congress that the ROTC program benefits be standardized. Specifically, the present system of financing the NROTC programs provides for tuition, books, and a $50 monthly allowance for four years, while Army and Air Force ROTC cadets do not receive comparable benefits, especially during the first two years. According to the Commission's report, this has attracted many exceptionally capable individuals into the Navy program purely for the financial benefits which it offers, although only 25% of these men remain in the service.

Your committee has been appointed to write a brief proposal to be submitted to the Joint Chiefs of Staff. This proposal should recommend a fair and equitable implementation of this policy, without exceeding the total of currently available funds for ROTC training, and justifying the recommendation as convincingly as possible.

You will have 25 minutes in which to complete your proposal."

Solution: Variable

Criterion: Judged quality of the proposal.

Source: F. E. Fiedler & W. Meuwese (personal communication from J. E. McGrath)

Dimension	Scale value	Q value
Cooperation requirements	3.83	2.68
Decision verifiability	0.84	1.88
Difficulty	4.36	3.17
Goal clarity	4.06	3.76
Goal path multiplicity	7.16	2.04
Intellectual-manipulative requirements	7.18	1.86
Intrinsic interest	4.50	3.38
Operational requirements	5.04	2.27
Population familiarity	4.62	2.76
Solution multiplicity	7.21	1.46

*****

Task 57

Materials: Paper and pencils. A copy of the following problem statement and instructions for each S.

Instructions: "A nation-wide program has been instituted to alert the public to our defense problems. The ROTC has been assigned the task of helping elementary school children understand our current national defense problems.

Your committee has been instructed to compose a fable or story for 8 to 10 year-old children which clearly shows the need for a large army in peace time. The fable or story must be clear to these young children, and as interesting and original as possible. Your main point should be that a trained land army is the most important element in the protection of a country even when it is not engaged in a major war, even when it must also protect its coast line.

Write down the complete fable or story, including an appropriate title. Remember that the story will be used with elementary school children.

You will have 25 minutes to complete your story."

Solution: Variable.

Criterion: Judged quality of the completed story.

Source: F. E. Fiedler & W. Meuwese (personal communication from J. E. McGrath)

Dimension	Scale value	Q value
Cooperation requirements	4.27	2.59
Decision verifiability	0.74	1.76
Difficulty	5.28	3.48
Goal clarity	4.44	3.93
Goal path multiplicity	7.23	1.82
Intellectual-manipulative requirements	7.09	2.42
Intrinsic interest	4.94	3.29
Operational requirements	5.61	3.08
Population familiarity	4.61	3.43
Solution multiplicity	7.39	0.62

*****

Task 58

Materials: Pencil. One copy of the following problem sheet:

LIST TEN POSSIBLE USES FOR EACH OF THE FOLLOWING OBJECTS:

a wire hanger (used for holding clothes)

1. _____
2. _____
3. _____

.
.
.

10. _____

a ruler (used for measuring length)

1. _____
2. _____
3. _____

.
.
.

10. _____

One copy of the following instructions for each S:

Instructions: "In this test your group will be asked to consider some common objects. Each object has a common use which will be given to you. Your group is to list ten other uses for which the object or parts of the object could serve. Remember that you must all agree on the ten uses."

For example:

Given: a newspaper (used for reading)

Your group might agree on the following other uses for a newspaper:

1. to start a fire
2. to wrap garbage in
3. to swat flies

4. stuffing to pack boxes
5. to line drawers or shelves
6. to make up a kidnap note

Note that all of the uses listed are different from each other and different from the primary use of a newspaper, which is for reading.

Remember, each use must be different from the others and different from the most common use which is given to you. In addition, do not use the same unusual use as a response to more than one object. In other words, none of your responses should occur more than once in the entire set.

Your group has a total of ten (10) minutes to agree on ten uses for each of the two items on the problem sheet.

Solution: 10 different and unusual uses for each object.

Criteria: Number of unusual uses listed; time required; unusualness of items listed.

Source: Parnes & Meadow, 1959.

Dimension	Scale value	Q value
Cooperation requirements	3.04	1.89
Decision verifiability	2.77	2.27
Difficulty	2.50	3.43
Goal clarity	5.75	2.85
Goal path multiplicity	6.42	1.80
Intellectual-manipulative requirements	6.35	2.20
Intrinsic interest	4.78	3.58
Operational requirements	3.93	3.60
Population familiarity	5.25	2.87
Solution multiplicity	6.21	2.01

*****

Task 59

Materials: Paper and pencils. Copy of question: "What makes for success in our culture?"

Instructions: "Your task is to discuss the question you have been given and decide among yourselves the five most important traits a person needs for success in our culture. When you have arrived at a decision, write the list of traits on a sheet of paper and hand it to me."

Solution: Variable

Criteria: Time; judged quality of decision.

Source: Cleveland & Fisher, 1957.

Dimension	Scale value	Q value
Cooperation requirements	3.94	2.61
Decision verifiability	0.77	1.82
Difficulty	3.50	4.40
Goal clarity	4.64	4.64
Goal path multiplicity	7.18	1.72
Intellectual-manipulative requirements	7.23	1.32
Intrinsic interest	5.64	3.43
Operational requirements	4.50	3.68
Population familiarity	5.71	2.48
Solution multiplicity	7.36	0.66

*****

Task 60

Materials: Pencils and paper; copy of the following instructions:

Instructions: "This is a study of group creativity. As a group, consider the practical benefits and/or difficulties that would arise if everyone born after 19__ (enter appropriate date) had an extra thumb on each hand. Discuss this among yourselves and prepare a group list of benefits and a list of difficulties that you foresee as a consequence of the extra thumb. You will have 15 minutes to complete the task."

Solution: Appropriate lists

Criteria: Number of benefits and difficulties listed; judged quality of items listed.

Source: Cohen, Whitmyre, & Funk, 1960.

Dimension	Scale value	Q value
Cooperation requirements	3.12	2.33
Decision verifiability	2.03	2.03
Difficulty	2.95	3.31
Goal clarity	5.08	3.98
Goal path multiplicity	6.79	1.83
Intellectual-manipulative requirements	7.09	1.48
Intrinsic interest	5.37	3.61
Operational requirements	3.50	4.55
Population familiarity	2.90	3.45
Solution multiplicity	6.97	1.34

*****

Task 61

Materials: Paper and pencils.

Instructions: "Your task is to discuss the question, 'Should college grades be abolished?'; to come to an agreement regarding the answer to this question; and to write a brief report concerning the agreement reached. You will have 15 minutes to complete this task."

Solution: Variable

Criteria: Quality of written report as judged by "experts."

Source: Blake, Mouton & Fruchter, 1954.

Dimension	Scale value	Q value
Cooperation requirements	3.86	2.51
Decision verifiability	0.77	1.42
Difficulty	3.75	4.33
Goal clarity	4.81	4.41
Goal path multiplicity	7.18	3,06
Intellectual-manipulative requirements	7.18	1.86
Intrinsic interest	6.14	2.16
Operational requirements	4.75	3.66
Population familiarity	5.45	3.56
Solution multiplicity	7.28	1.24

*****

Task 62

Materials: Paper and pencils. Copy of the following statement: "The church as an institution is outdated and serves no useful function in modern society."

Instructions: "Your task is to discuss the statement you have been given and to reach a conclusion as to your acceptance or rejection of this statement. During the discussion, try to answer the following questions:

1. What functions does the church serve in our society?
2. Are these functions necessary to modern man?
3. Can these functions be served equally well by other social institutions?

Come to some agreement among yourselves and write a conclusion setting forth your reasons for accepting or rejecting the statement."

Solution: Variable.

Criteria: Time; judged quality of conclusion; number of reasons given.

Source: Carter, Haythorn, Meirowitz, & Lanzetta, 1951.

Dimension	Scale value	Q value
Cooperation requirements	4.12	2.30
Decision verifiability	0.82	1.72
Difficulty	4.62	4.22
Goal clarity	5.42	4.18
Goal path multiplicity	7.16	1.88
Intellectual-manipulative requirements	7.21	1.38
Intrinsic interest	5.94	2.97
Operational requirements	5.31	3.09
Population familiarity	5.85	2.52
Solution multiplicity	7.34	0.66

*****

Task 63

Materials: Paper and pencils. Copies of the following problem statement:

(a) Captain Watts and his son James have been found shot - the father in the chest and the son in the back. (b) Both clearly died instantaneously. (c) A gun fired close to the person - as, for example, when a man shoots himself - will blacken and even burn the skin or clothes; fired from a greater distance it will leave no such mark. (d) The two bodies were found near the middle of a large hall used as a rifle range. (e) Its floor is covered with damp sand which shows every footprint distinctly. (f) Inside the room there are two pairs of footprints only. (g) A third man standing outside the door or window could aim at any part of the room, but the pavement outside would show no footmarks. (h) Under Captain Watts' body was found a gun; no such weapon was found near James. (i) In each case the coat, where the bullet entered, was blackened with gunpowder, and the cloth a little singed. (j) Captain Watts was devoted to his son and would have died sooner than harm him purposely; hence it is impossible to suppose that he killed him deliberately, even in self defense. (k) But some think that James secretly disliked his father and hoped to inherit his fortune at his death.

1) To what was Captain Watts' death due? Murder? Accident? Suicide?
2) To what was James' death due? Murder? Accident? Suicide?

Instructions: "Assume that you are a coronor's jury. Your task is to decide how Captain Watts and his son met their fate. Discuss the "evidence" among yourselves and decide how the two questions posed at the end of the problem statement should be answered. Write a short explanation of the events leading up to the deaths of Captain Watts and his son; i.e., explain how you decided upon the causes of their death."

Solution: Captain Watts - suicide
James - accident

Criteria: Number of correct answers (0, 1, or 2); time required; judged quality of explanation.

Source: Burack, 1950.

Dimension	Scale value	Q value
Cooperation requirements	2.62	2.40
Decision verifiability	5.06	3.39
Difficulty	4.72	2.71
Goal clarity	5.56	2.92
Goal path multiplicity	3.78	2.66
Intellectual-manipulative requirements	7.12	1.84
Intrinsic interest	6.06	2.63
Operational requirements	3.78	2.98
Population familiarity	4.62	2.57
Solution multiplicity	1.05	2.41

*****

Task 64

Materials: Paper and pencils. A copy of the following problem statement for each group member:

"Paul, a sophomore at a state university, knows that a certain group of boys have bribed a person in the mimeograph office and obtained a copy of an important exam. He knows that if he exposed the bribe the exam would be changed, but the people involved, many of whom he knows quite well, would be caught, and since the university enforces the rules against cheating very strictly, would probably be suspended from the school, or at least given an F in the course. Such an action would obviously make Paul extremely unpopular with the students during the rest of his stay. He can afford to go nowhere else.

Paul is an average student, but a series of personal problems last semester affected his studies and caused him to be put on probation. He has to pass this very rough course to stay in college, and he is just on the borderline between passing and failing.

The gang with the stolen exam has offered to cut Paul in on it, since they know that Paul had seen a copy in the hands of one of the fellows in the dorm; but Paul has strong moral feelings against cheating and has turned down the offer. But since the course is graded on the curve, he feels that the added advantage of the others would be sufficient in such a small class to cause him to fail. What should he do?"

The following are possible solutions:

A. Consult with teacher.

B. Keep mum and take the test as is.

C. Try to convince the other fellows not to use the exam to study by.

D. Seek aid to problem from minister.

E. Inform officials that exam had been passed among the students; he could do this in a letter, hence would not involve himself.

Instructions: "This is a group task. Discuss the case you have been given among yourselves and try to arrive at a concensus regarding which of the suggested solutions is the best one. You will have 15 minutes to discuss the case and make your decision."

Solution: Quality of decisions: A-3, B-4, C-1, D-5, E-2 (the smaller the number, the better the decision)

Criteria: Quality of decision; unanimity of decision.

Source: Bass, 1960b.

Dimension	Scale value	Q value
Cooperation requirements	3.73	2.66
Decision verifiability	2.35	2.17
Difficulty	3.14	2.29
Goal clarity	6.07	3.16
Goal path multiplicity	5.63	1.83
Intellectual-manipulative requirements	7.34	0.66
Intrinsic interest	6.39	2.33
Operational requirements	3.92	4.31
Population familiarity	6.36	2.37
Solution multiplicity	4.04	2.43

*****

Task 65

Materials: Paper and pencils. A copy of the following statement for each group member:

"Mr. Lee, a college graduate and successful lawyer, Vice President of the Citizen's Reform League, President of Rotary and Past Exalted Ruler of the Elks, ex-mayor of Amden, is now being spoken of as a possibility for next year's nomination for the U.S. House of Representatives. But Mr. Lee's wife, Cordelia, over the past ten years of his rise to success, has become an alcoholic, drinking more and more and keeping close to her home, never joining her husband in any of his activities. He loves his wife deeply and wants to help her. He has sent her to a sanatorium for treatment and has solicited the aids of the family doctor and rector, but, though there was a temporary improvement, Cordelia started to drink heavily as soon as she returned home. As an alcoholic, Cordelia stands in the way of possible future success for Mr. Lee,

yet a divorce would hurt his political career. Mr. Lee has explained his wife's behavior as poor health resulting from the miscarriage of their first and only child a few years before. He continues to work tirelessly on his projects 13 or more hours a day even with ulcers and anxiety. What do you recommend to Mr. Lee? The following are possible solutions:

A. Enroll his wife in Alcoholics Anonymous.

B. Pay more attention to the needs of his wife.

C. Continue serving the public without the aid of his wife.

D. Adopt children, if possible, so his wife will have continuous companionship.

E. Temporarily give up politics until his wife's illness is cured.

Instructions: "This is a group task. Discuss the case you have been given and try to arrive at a consensus regarding which of the suggested solutions is the best one. You will have 15 minutes to discuss the case and make your decision."

Solution: Quality of decisions: A-3, B-1, C-5, D-4, E-2 (the smaller the number, the better the decision)

Criteria: Quality of decision; unanimity of decision.

Source: Bass, 1960b.

Dimension	Scale value	Q value
Cooperation requirements	3.77	2.76
Decision verifiability	2.50	2.20
Difficulty	3.05	2.37
Goal clarity	5.64	3.37
Goal path multiplicity	5.62	1.69
Intellectual-manipulative requirements	7.34	0.66
Intrinsic interest	6.25	2.43
Operational requirements	4.50	3.64
Population familiarity	5.94	2.70
Solution multiplicity	4.11	2.56

*****

Task 66

Materials: Paper and pencils. A copy of the following statement for each group member:

"Stuart is a dynamic, popular young fellow who, after holding minor offices, managed to get elected to the state senate when only four years out of college. He is married and has one child. During his term of office a bill has been introduced to give everyone over 55 a pension of $150 a month. Though the bill has wide public support and publicity, Stuart knows it would impose very severe taxes on the younger population and possibly bankrupt the state. Thus, he regards it as the most dangerous bill to come up in the last twenty years. A group of lobbyists have called and made it clear that to stand against the bill would cost him his office, and they even named several mediocre individuals they could put in his place. Furthermore, it seems to Stuart that the lobbyists probably can carry out their threat to replace him with someone else, since there is pressure upon all state senators from the party bosses and public opinion is strongly in favor of the bill. They asked for his decision the next day. What should Stuart do? The following are possible solutions:

A. Work to get all Senators to vote against the bill and do the same.

B. Start a long range program that would start slowly and advance according to the ability of the state.

C. Fight by making appeal to young voters.

D. Make a counter offer changing the age to older and amount of the pension to a lower amount.

E. Talk to the public over the radio and get the public to see that the bill is a bad one.

Instructions: "This is a group task. Discuss the case you have been given among yourselves and try to arrive at a consensus regarding which of the suggested solutions is the best one. You will have 15 minutes to discuss the case and make your decision."

Solution: Quality of decisions:

A-3
B-1
C-5
D-2
E-4

(the smaller the number, the better the decision)

Criteria: Quality of decision; Unanimity of decision.

Source: Bass, 1960b.

Dimension	Scale value	Q value
Cooperation requirements	3.77	2.71
Decision verifiability	2.42	2.15
Difficulty	3.19	2.24
Goal clarity	5.50	3.24
Goal path multiplicity	5.62	1.66
Intellectual-manipulative requirements	7.32	0.86
Intrinsic interest	5.85	2.60
Operational requirements	4.30	3.59
Population familiarity	5.55	2.93
Solution multiplicity	4.11	2.56

*****

Task 67

Materials: Paper and pencils. A copy of the following statement for each member of the group:

"A young business executive is faced with a rather serious problem in his personal life. Here is his story:

'I have been married six years and have a son four years old. My wife and I have always been very much in love with each other, and we have never had any serious disagreements. My wife is a very intelligent person, and she still remembers her father's unfaithfulness to her mother and the shame and humiliation which she and her mother suffered as a result. Consequently, she regards faithfulness as the one indispensable condition for a successful marriage. I agree that faithfulness is important, but I feel that above all a husband and wife should always be completely frank with each other if their relationship is to be a happy one.

About two years ago, we purchased our "dream house" in a small town in New Jersey. Since that time, I have commuted 75 miles a day to and from my office in New York City. Consequently, I have frequently found it convenient to work late and stay overnight in the city, rather than spoil a week-end by going to work on Saturday. My job is such that I must have secretarial help, and it was only natural that my regular secretary should work late with me.

At first, all went along as usual. Then I developed the habit of going out to dinner after work, and, again, it seemed only natural that I take my secretary along with me. (After all, she was human and got hungry, too.) My secretary was a very attractive and understanding young woman, and . . . well, to make a long story short, one thing led to another, and soon I was spending as many evenings with her as possible. Of course my secretary knew that I was married, and that our relationship was superficial and temporary; but she seemed to enjoy my company as much as I did hers. The whole affair ended more than six months ago when my secretary resigned to get married.

I have never memtioned this affair to my wife. At first, it seemed harmless enough; later, it became so involved that I did not

know how to explain it to her. I tried to bring it up once by talking about my work, but my wife remarked that she was horrified by some of the stories she had heard about executives becoming involved with their secretaries. She was sure, she said, that such a terrible thing could never happen to us. Naturally, I could not tell her after that.

I feel terribly guilty and feel that if I don't tell her there will always be a barrier between us which would make our marriage deceitful, and yet I am afraid that if I do tell her, it will be a blow to my wife that might break up our marriage.'

What do you think is the wisest thing for him to do, assuming that for his own peace of mind he can't just forget the matter?"

Instructions: "Your task is to analyze the situation described in the material you have been given, and give the business executive advice about how to proceed. You may discuss it among yourselves and arrive at a joint decision. When you have arrived at a decision, write it on the paper you have been supplied and hand it to me."

Solution: Variable

Criteria: Time to reach a decision; judged quality of decision.

Source: Deutsch, 1949, Shaw, Rothschild, & Strickland, 1957.

Dimension	Scale value	Q value
Cooperation requirements	3.73	2.56
Decision verifiability	0.98	2.00
Difficulty	4.08	3.82
Goal clarity	4.83	4.42
Goal path multiplicity	7.21	1.58
Intellectual-manipulative requirements	7.28	1.24
Intrinsic interest	7.16	3.42
Operational requirements	4.69	3.77
Population familiarity	6.19	3.01
Solution multiplicity	7.34	0.66

*****

Task 68

Materials: A copy of the following problem statement for each group member:

"Sam, a student in the 8th grade, is, in the words of his principal, "A bad case who is headed for the juvenile court." The principal would like to expel Sam, but hesitates to do so because Sam's father is influential in the town. The principal has tried everything with Sam - called him down, pleaded with him, made him sit in the office with his face to the wall, used corporal punishment, called Sam's parents, and placed him on probation. Sam still remains impudent and truant. The principal has written Sam's mother asking her to come to the school to talk over Sam's behavior, but she phoned to say she is too busy and has no time to bother with his school problems. Sam is at present on probation. What should be done with Sam? The following are suggested solutions:

A. Send Sam to a psychiatrist, child psychologist, or social welfare counselor.

B. Try to stimulate Sam toward goals which might gain him greater acceptance.

C. Try to get his parents to realize the seriousness of the situation.

D. The whole family should be sent to a psychiatrist, psychologist, or social welfare counselor.

E. Attempt to determine why he is the way he is and institute a campaign to correct the reason."

Instructions: "This is a group task. Discuss the case you have been given and try to arrive at a consensus regarding which of the suggested solutions is the best one. You will have 15 minutes to discuss the case and make your decision."

Solution: Quality of decision: A-2, B-4, C-3, D-5, E-1 (the smaller the number, the better the decision)

Criteria: Quality of decision; unanimity of decision.

Source: Bass, 1960b.

Dimension	Scale value	Q value
Cooperation requirements	3.86	2.60
Decision verifiability	2.54	2.28
Difficulty	3.25	2.48
Goal clarity	5.88	3.57
Goal path multiplicity	5.62	1.69
Intellectual-manipulative requirements	7.37	0.62
Intrinsic interest	6.45	2.11
Operational requirements	4.38	3.77
Population familiarity	5.50	3.04
Solution multiplicity	3.92	2.45

*****

Task 69

Materials: A copy of the following statement of the problem for each group member:

"Henry, the son of a physician, has a friend, Jim, who is under the care of Henry's father. Henry knows that Jim is incurably ill. Both are in love with a girl, Ellen. Jim doesn't know what kind of disease he has; neither does Ellen know that he is incurably ill. One night Henry calls on Ellen just after he has decided to give up his studies and accept a job in California. He intends to ask her that night to marry him and go with him to California. Henry knows that for many years Ellen has wanted to go to live there. Before he gets a chance to tell her, however, Ellen announces her engagement to Jim.

What should Henry say and do?"

Instructions: "Your task is to give advice regarding the interpersonal problem you have been given. After reading the problem, you will be given an opportunity to discuss possible decisions. Try to find a solution that is acceptable to all, but if you cannot agree, a minority report will be accepted. When you have agreed upon a solution, or have agreed that you cannot reach a unanimous decision, the discussion will be terminated. At that time, please write your decision on the card provided and hand it to me. If a minority report is submitted, please indicate who supported each proposition."

Solution: Variable

Criteria: Time to reach a decision; number of members agreeing with majority decision; judged quality of decision.

Source: Festinger & Hutte, 1954.

Dimension	Scale value	Q value
Cooperation requirements	3.45	2.79
Decision verifiability	0.91	1.80
Difficulty	4.36	3.89
Goal clarity	4.44	4.38
Goal path multi plicity	7.23	1.64
Intellectual-manipulative requirements	7.30	1.00
Intrinsic interest	7.02	3.14
Operational requirements	4.95	3.25
Population familiarity	5.58	3.34
Solution multiplicity	7.26	1.28

*****

Task 70

Materials: Mimeographed copies of the following statement of the problem (one copy for each group member):

"The School Board of your town has gone progressive. The Board realizes that teachers cannot do everything and are planning to obtain a staff of specialists in various areas to cope with the several problems which teachers are unable to handle effectively. Consider yourselves as the chairmen of the 10 departments of your high school of 5,000 students. You are meeting thirty minutes before the School Board goes into session. The present high school consists of teachers, the principal, an office staff, and a janitorial staff. Your problem is to agree upon the four specialists you will ask for, and the reasons you will present for choosing those four. The School Board will only appropriate $12,000. Remember, there are 5,000 students so don't plan on overloading the four specialists."

Instructions: "You will be given a problem and will have 30 minutes in which to discuss it. You will be graded not only on how well you as an individual contribute to the group discussion, but also on how well the group does as a whole.

Everyone may receive an A or everyone may receive an E depending on how much he contributes and how much the group progresses. Therefore, if you feel someone else is "off the track," is wasting the group's time and there is lowering your grade, feel free to cut in and get the group back on its proper assignment."

Solution: Variable

Criterion: Judged quality of solution.

Source: Bass, 1949.

Dimension	Scale value	Q value
Cooperation requirements	4.39	2.72
Decision verifiability	1.12	1.54
Difficulty	5.05	3.28
Goal clarity	3.50	3.28
Goal path multiplicity	6.89	1.45
Intellectual-manipulative requirements	7.43	0.56
Intrinsic interest	4.29	2.59
Operational requirements	5.50	3.00
Population familiarity	4.64	3.43
Solution multiplicity	7.12	1.84

*****

Task 71

Materials: Each group member is provided with a copy of the following statement:

"A bomber crew was downed over Norway during the winter of 1944. With the help of the underground, radio contact had been established with friendly forces and submarine had been dispatched to pick them up at a given time and place on the coast. In order to insure the safety of the submarine and because of the danger of being spotted on the coast, the crew delayed its dash to the coast as long as they dared to. As the crew headed to the pick-up point, they became aware that enemy troups were on their trail. The crew had reason to believe that the pursuers were less than a day's distance behind. At this point, the crew arrived at a fiord which was about four miles wide and on the other side was the pick-up point. The fiord was covered with ice, but because of the snow covering it, it was impossible to tell how thick it was. Furthermore, no one in the group knew the characteristics of fiord ice at that time of the year. The distance around the fiord to the pick-up point was about 15 miles over difficult terrain. Looking around, the group saw a dwelling about 8 miles away at the most inland point of the fiord. Given only these conditions, what would your decision have been?"

Instructions: "Your task is to discuss the problem and arrive at a group decision. You may attack the problem in any way that you choose, the only restrictions being that the various aspects of the situation be considered by the group and that a decision be arrived at by the group. When you have a decision, write it on the paper provided and hand it to me."

Solution: Variable.

Criteria: Time; judged quality of decision.

Source: Ziller, 1957.

Dimension	Scale value	Q value
Cooperation requirements	3.86	2.74
Decision verifiability	1.50	1.84
Difficulty	3.75	3.54
Goal clarity	4.39	4.13
Goal path multiplicity	7.06	2.42
Intellectual-manipulative requirements	7.26	1.46
Intrinsic interest	5.65	2.84
Operational requirements	3.94	3.90
Population familiarity	4.15	2.64
Solution multiplicity	7.16	1.36

*****

Manipulation Tasks

Task 72

Materials: Several pieces of glass tubing and rubber tubing, 6 to 12 inches in length; poles several feet in length; several paper clamps; two candles. (Materials are placed on table along with other assorted materials; candles are placed about two feet apart on the table and lighted.)

Instructions: "This is a test of group problem-solving. Your task, working as a group, is to devise a way of blowing out the candles while standing 8 feet away. You may use any of the materials that are on the table. Work rapidly. You will be judged in terms of the time required to blow out the candles."

Solution: A long tube can be constructed by connecting the pieces of glass tubing together with the rubber tubing. Clamps are used to fasten the tube to the long poles to make it rigid. Then the candles can be blown out by placing one end of the tube near the flame and blowing through the other end.

Criterion: Time required to blow out the candles.

Source: Maier, 1930.

Dimension	Scale value	Q value
Cooperation requirements	4.35	3.40
Decision verifiability	6.25	2.09
Difficulty	2.54	2.83
Goal clarity	5.21	4.00
Goal path multiplicity	2.81	2.93
Intellectual-manipulative requirements	1.86	1.71
Intrinsic interest	4.42	3.26
Operational requirements	4.50	3.92
Population familiarity	2.50	2.52
Solution multiplicity	2.32	2.26

*****

Task 73

Materials: Ball and spiral apparatus. This consists of a spiral track 3½ inches wide ascending from a circular base 4 inches in diameter to a center hole in the top about 24 inches above the base. There are 3 3/4 rotations of the track, the outside of which is open so that a rubber ball can roll off freely. Five handles are mounted on the base, spaced at equal intervals. A rubber ball is placed at the bottom of the track at the beginning of each trial.

Instructions: "This is a test of group cooperation in a manual dexterity task. By appropriate manipulation, it is possible to make this rubber ball roll to the top of the track and enter the hole in the top. Each person will grasp one of the handles with his right hand. Then, working as a team, try to cause the ball to roll to the top of the track without falling off. Each time the ball falls off, I will replace it at the bottom of the track and a new trial begins. You will have ten trials to try to move the ball to the top. Are there any questions?"

Solution: Moving the ball as far up the track as possible on each trial.

Criteria: Mean height of ball per trial before falling off track; mean time per trial that ball is kept on track.

Source: French, 1941.

Dimension	Scale value	Q value
Cooperation requirements	7.28	1.12
Decision verifiability	6.17	3.24
Difficulty	2.77	3.54
Goal clarity	6.04	2.91
Goal path multiplicity	3.07	3.40
Intellectual-manipulative requirements	0.66	0.66
Intrinsic interest	5.36	3.60
Operational requirements	2.28	3.08
Population familiarity	2.56	2.83
Solution multiplicity	3.61	3.55

*****

Task 74

Materials: A dynamometer with 1" x 30" steel pipes attached at each end; a set of canvas shoe covers for each S.

Instructions: "You are to use this as a kind of tug-of-war. You should divide up in any way you choose, then you are to pull against each other and make this dynamometer register as high as possible. You need to keep as strong a steady pull as possible. The lowest point to which you let the pointer fall during each 15 second test period will be your score. Of course you will want to make a high score. Now, you have three minutes to organize - decide how you want to distribute yourselves, etc. When you are ready, I will give you a few seconds to get the pointer up toward its maximum, then I will announce the beginning of the test period. There will be ten test periods, with two minute rest periods between periods."

Solution: Maintenance of pointer at high level.

Criteria: Mean score per trial, based upon lowest point to which pointer falls.

Source: Cattell, Saunders, & Stice, 1953.

Dimension	Scale value	Q value
Cooperation requirements	7.16	2.04
Decision verifiability	5.93	3.71
Difficulty	1.06	2.08
Goal clarity	6.47	1.80
Goal path multiplicity	2.08	3.67
Intellectual-manipulative requirements	0.61	0.62
Intrinsic interest	5.04	3.84
Operational requirements	0.88	2.92
Population familiarity	3.15	3.47
Solution multiplicity	3.72	3.69

*****

Task 75

Materials: Four poles varying in length, one table clamp (C clamp), two burette clamps, two pieces of wire, several pieces of chalk,,and several weights (lead tubing, bolts, or similar materials). (Two chalk marks are placed on the floor. One pole must be as long as the distance between the chalk marks, and two of the remaining poles must together equal the distance from floor to ceiling, plus enough overlap for the C clamp to hold them together.)

Instructions: "We are interested in observing how groups of individuals work together on a construction problem. Your task, working as a group, is to construct two pendulums, each holding a piece of chalk, which will swing over the chalk marks already on the floor, and will mark the floor. Your performance will be judged on the basis of time required to complete the task and the quality of the finished product."

Solution: Completion of required pendulums. (This is accomplished by making an upright using two poles clamped together and braced between the floor and ceiling, and attaching other poles to this upright. Strings and weights can then be attached to these poles to make the pendulums.)

Criteria: Time required to complete the task; judged quality of the finished project.

Source: Maier, 1930.

Dimension	Scale value	Q value
Cooperation requirements	5.03	2.67
Decision verifiability	5.85	2.99
Difficulty	2.96	3.13
Goal clarity	3.94	4.05
Goal path multiplicity	2.03	2.86
Intellectual-manipulative requirements	1.96	1.88
Intrinsic interest	3.65	3.39
Operational requirements	5.06	3.72
Population familiarity	2.62	2.78
Solution multiplicity	2.29	2.34

*****

Task 76

Materials: Two model train engines, each fitted with one car; two transformers with power and directional controls; circular track (4' in diameter) with three sidings spaced at equal intervals around the track; three siding switch controls - one for each siding.

Instructions: "We are interested in observing how teams of individuals work together in carrying out cooperative tasks. This train set has five controls: one control for each of the two trains and one control for each of the three sidings. Each of you will operate one of the controls. Your task is to run both trains around the track in opposite directions as many times as possible in a three minute trial period. You will be given two points for each complete circuit of the track, with the restriction that both trains must make the same number of trips in any one trial. That is, you will not get credit for simply running one train around the track again and again. Also, accuracy is important, so you will be penalized for recklessness. You will lose five points each time there is a wreck; i.e., when a train derails or the two trains run together. There will be 12 three-minute trial periods with a one-minute rest period after each trial. You may talk to each other at any time. Are there any questions?"

Solution: Coordination of effort so that one train is on siding while other passes.

Criteria: Net points earned; mean number of circuits per trial; mean number of wrecks per trial.

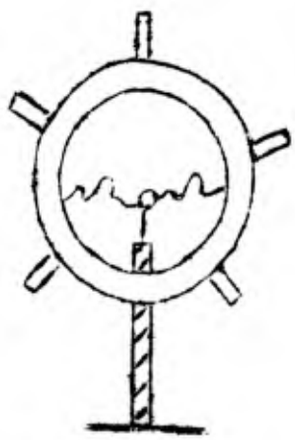
Source: Ghiselli & Lodahl, 1953.

Dimension	Scale value	Q value
Cooperation requirements	7.23	1.26
Decision verifiability	5.50	3.31
Difficulty	3.21	3.25
Goal clarity	5.12	2.54
Goal path multiplicity	3.50	2.85
Intellectual-manipulative requirements	1.84	2.08
Intrinsic interest	6.93	2.95
Operational requirements	4.35	2.89
Population familiarity	3.50	3.46
Solution multiplicity	3.30	3.46

*****

Task 77

Materials: Apparatus consisting of an irregularly bent length of wire, 3/16 inch in diameter, which runs from one side to the other of a circular hole, 2 ft. in diameter, cut in a circular board, 3 ft. in diameter. Five handles are attached at equal intervals around the outside of the circular board. A loop of 3/16 inch wire, with an inner diameter of 7/8 inch, encircles the wire across the hole in the circular board. This loop is mounted on a stand so that it stands 3 ft. 10 in. high. A buzzer and counter are attached to the ring and wire so that each time the wire makes contact with the ring, the buzzer will sound and the counter will record the contact. The apparatus looks something like this:



(One S is stationed at each handle.)

Instructions: "This is a group task. Your job is to move the wire through the ring as quickly and with as little contact with the ring as possible. Each time contact is made, a buzzer will sound and the contact will be recorded on this counter (point). Your score will be the number of contacts recorded; the more contacts, the poorer will be your performance. You will be given 10 trials.

Solution: Moving the wire through the ring with no contact.

Criterion: Mean number of contacts per trial.

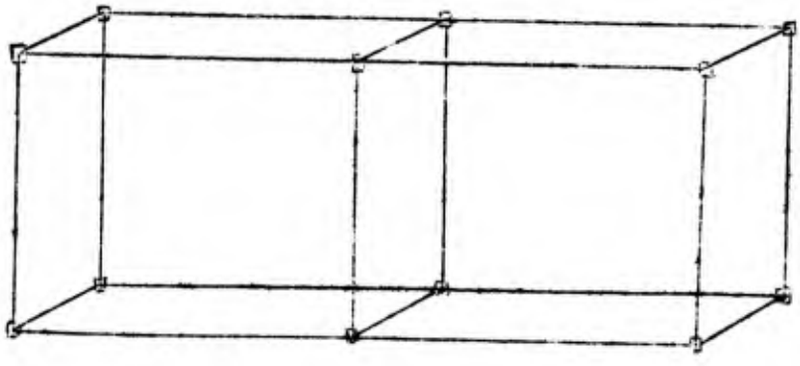
Source: Laties, 1961.

Dimension	Scale value	Q value
Cooperation requirements	7.06	4.62
Decision verifiability	6.92	3.76
Difficulty	2.38	2.65
Goal clarity	6.55	2.35
Goal path multiplicity	1.64	3.21
Intellectual-manipulative requirements	0.63	0.62
Intrinsic interest	4.42	3.94
Operational requirements	1.55	2.74
Population familiarity	1.97	2.77
Solution multiplicity	1.73	2.86

*****

Task 78

Materials: Diagram of model:



Building materials: 6 round sticks, 6 in. long, $\frac{1}{4}$ inch in diameter (at both ends); 6 sticks 8 in. long, $\frac{1}{4}$ in. in diameter (at both ends); 8 sticks, 12 inches long, $\frac{1}{2}$ inch in diameter at one end, $\frac{1}{2}$ inch in diameter at the other end; 8 connecting blocks, each having one larger hole ($\frac{1}{2}$ inch diameter) and 5 smaller holes ($\frac{1}{4}$ inch diameter); 4 connecting blocks, each having 6 smaller holes ($\frac{1}{4}$ inch diameter).

One copy of instructions as follows (read to group, then give copy for reference).

Instructions: "Here are a number of sticks and some joint pieces. You are to use these to construct a model that will look like this (show model diagram). Do the job as quickly as possible. The group score will be in terms of the time you take to do the job. Notice that there are three lengths of sticks. Some sticks are just alike on both ends, but others have different size ends.

Notice also that the blocks are of different kinds - some have all holes of the same size, some have different size holes."

Solution: Completion of model

Criterion: Construction time.

Source: Cattell, Saunders, & Stice, 1953.

Dimension	Scale value	Q value
Cooperation requirements	4.69	2.94
Decision verifiability	7.18	3.30
Difficulty	3.05	2.37
Goal clarity	6.28	3.27
Goal path multiplicity	2.83	3.27
Intellectual-manipulative requirements	1.47	1.66
Intrinsic interest	3.94	2.91
Operational requirements	3.42	3.93
Population familiarity	4.07	3.91
Solution multiplicity	1.37	1.64

*****

Task 79

Materials: Open booths, one for each group member, arranged side by side and fitted with work tables and a communication system. (A standard intercom system with mike and headphones for each person is adequate.)

A slide projector for each booth, or other means of presenting a series of pictures of simulated aircraft instruments to each S, and 30 pictures showing different instrument readings.

A switch, having an "off" and 3 "on" positions, in each booth. Each switch is labelled as an aircraft control, e.g., steering mechanism.

The sets of 30 simulated instruments represent the following instruments: altimeter, air speed indicator, compass, rate of climb indicator, fuel gauge, and air temperature gauge. The controls are: landing gear, steering mechanism, control switch, selector knob, and power setting. The operation of controls, instrument requirements, and availability of instruments is shown in the following chart:

Member	Control operated	Instrument readings required	Instrument readings available
A	Landing gear	altimeter, air speed ind.	compass, air temp.
B	Steering mechanism	compass, altimeter	air temperature, rate of climb
C	Control switch	compass, rate of climb	altimeter, fuel gauge
D	Selector knob	fuel gauge, air temp.	air speed indicator, compass
E	Power setting	air speed indicator, rate of climb	fuel gauge, altimeter

Thus, each S operates one control, needs two readings that he does not have, and has two readings that he does not need. Some needed readings are available for two other Ss, others from only one other S. Each S has a card which tells what the setting should be at various instrument readings, e.g., Member A has the following card:

Operating Procedures: Landing Gear

When altimeter reading is:	And Air Speed reading is:	Landing gear position should be:
500	High	1
	Medium	2
	Low	3
2,000	High	1
	Medium	2
	Low	3
10,000	High	1
	Medium	2
	Low	3

Instructions: "Instructions explain the operation of the apparatus and materials, with examples. Communication procedures are explained. Ss are told that they must obtain the necessary information from others and are provided with an information card which tells which persons have which instruments. They are told that instrument readings will change periodically, but they are not told how often changes occur. They are told that performance will be judged in terms of speed and accuracy of switch settings."

Solution: Agreement of switch settings with instrument readings and specifications listed on "Operating Procedures" card.

Criteria: Number of errors, where an error is defined as an incorrect switch setting by any S. Setting not changed before next instrument reading change is considered as an error.
Latency of change of setting following instrument reading change.

Source: Roby & Lanzetta, 1956. (Cf. Lanzetta & Roby, 1956)

Dimension	Scale value	Q value
Cooperation requirements	7.16	1.88
Decision verifiability	5.95	2.73
Difficulty	5.61	2.74
Goal clarity	2.08	3.41
Goal path multiplicity	3.36	2.86
Intellectual-manipulative requirements	3.32	2.36
Intrinsic interest	5.56	3.36
Operational requirements	6.39	2.24
Population familiarity	1.58	3.38
Solution multiplicity	1.96	2.59

*****

Ranking Tasks

Task 80:

Materials: Pencils. List of cities to be ranked:

City	Rank
Lincoln, Nebraska	_____
Elizabeth, New Jersey	_____
Fort Wayne, Indiana	_____
Tulsa, Oklahoma	_____
Madison, Wisconsin	_____
San Diego, California	_____

Instructions: "Your task will be to rank the cities listed on the problem sheet according to their population as indicated by the 1960 census. That is, assign a rank of 1 to the city which has the largest population, a rank of 2 to the city which has the next largest population, etc. Are there any questions about this procedure? (Make sure task is understood by everyone.) You will be given 10 minutes to discuss the problem and arrive at a group ranking."

Solution:

City	Rank
Lincoln, Nebraska	4
Elizabeth, New Jersey	6
Fort Wayne, Indiana	3
Tulsa, Oklahoma	2
Madison, Wisconsin	5
San Diego, California	1

Criteria: Correlation of group ranking with true ranking; time.

Source: Gaier & Bass, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.81	2.63
Decision verifiability	7.32	0.86
Difficulty	2.50	3.40
Goal clarity	7.32	0.88
Goal path multiplicity	1.95	2.73
Intellectual-manipulative requirements	6.88	1.67
Intrinsic interest	2.28	2.95
Operational requirements	1.21	1.90
Population familiarity	3.85	3.73
Solution multiplicity	0.91	1.68

*****

Task 81

Materials. List of cities to be ranked; pencils.

City	Rank
South Bend, Indiana	_____
Little Rock, Arkansas	_____
Jacksonville, Florida	_____
Portland, Oregon	_____
Charlotte, North Carolina	_____
Lowell, Massachusetts	_____

Instructions: "Your task will be to rank the cities listed on the problem sheet according to their population as indicated by the 1960 census. That is, assign a rank of 1 to the city which has the largest population, a rank of 2 to the city which has the next largest population, etc. Are there any questions about this procedure? (Make sure task is understood by everyone.) You will be given 10 minutes to discuss the problem and arrive at a group ranking."

Solution:

City	Rank
South Bend, Indiana	4
Little Rock, Arkansas	5
Jacksonville, Florida	3
Portland, Oregon	1
Charlotte, North Carolina	2
Lowell, Massachusetts	6

Criteria: Correlation of group ranking with true ranking; time.

Source: Gaier & Bass, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.81	2.63
Decision verifiability	7.32	0.86
Difficulty	2.50	3.51
Goal clarity	7.30	1.18
Goal path multiplicity	1.86	2.70
Intellectual-manipulative requirements	6.88	1.67
Intrinsic interest	2.28	2.95
Operational requirements	1.19	1.79
Population familiarity	3.85	3.73
Solution multiplicity	0.91	1.68

*****

Task 82

Materials: Pencils, List of cities to be ranked:

City	Rank
Tacoma, Washington	_____
Albany, New York	_____
Norfolk, Virginia	_____
Columbus, Ohio	_____
Canton, Ohio	_____
Jackson, Mississippi	_____

Instructions: "Your task will be to rank the cities listed on the problem sheet according to their population as indicated by the 1960 census. That is, assign a rank of 1 to the city which has the largest population, a rank of 2 to the city which has the next largest population, etc. Are there any questions about this procedure? (Make sure task is understood by everyone.) You will be given 10 minutes to discuss the problem and arrive at a group ranking."

Solution:

City	Rank
Tacoma, Washington	3
Albany, New York	5
Norfolk, Virginia	2
Columbus, Ohio	1
Canton, Ohio	6
Jackson, Mississippi	4

Criteria: Correlation of group ranking with true ranking; time.

Source: Gaier & Bass, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.88	2.46
Decision verifiability	7.32	0.86
Difficulty	2.44	3.43
Goal clarity	7.30	1.18
Goal path multiplicity	1.86	2.70
Intellectual-manipulative requirements	6.81	1.64
Intrinsic interest	2.28	2.90
Operational requirements	1.19	1.73
Population familiarity	3.77	3.73
Solution multiplicity	0.88	1.70

*****

Task 83

Materials: Pencils. List of cities to be ranked:

City	Rank
Seattle, Washington	_____
Mobile, Alabama	_____
Jersey City, New Jersey	_____
Youngstown, Ohio	_____
Minneapolis, Minnesota	_____
Corpus Christi, Texas	_____

Instructions: "Your task will be to rank the cities listed on the problem sheet according to their population as indicated by the 1960 census. That is, assign a rank of 1 to the city which has the largest population, a rank of 2 to the city which has the next largest population, etc. Are there any questions about this procedure? (Make sure task is understood by everyone.) You will be given 10 minutes to discuss the problem and arrive at a group ranking.

Solution:

City	Rank
Seattle, Washington	1
Mobile, Alabama	4
Jersey City, New Jersey	3
Youngstown, Ohio	5
Minneapolis, Minnesota	2
Corpus Christi, Texas	6

Criteria: Correlation of group ranking with true ranking; time.

Source: Gaier & Bass, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.88	2.46
Decision verifiability	7.32	0.86
Difficulty	2.55	3.42
Goal clarity	7.30	1.10
Goal path multiplicity	1.95	2.73
Intellectual-manipulative requirements	6.81	1.64
Intrinsic interest	2.28	2.90
Operational requirements	1.12	1.82
Population familiarity	3.77	3.73
Solution multiplicity	0.88	1.58

*****

Task 84

Materials: Pencils. List of cities to be ranked:

City	Rank
Wilmington, Delaware	_____
Fall River, Massachusetts	_____
Erie, Pennsylvania	_____
Houston, Texas	_____
Birmingham, Alabama	_____
Hartford, Connecticut	_____

Instructions: "Your task will be to rank the cities listed on the problem sheet according to their population as indicated by the 1960 census. That is, assign a rank of 1 to the city which has the largest population, a rank of 2 to the city which has the next largest population, etc. Are there any questions about this procedure? (Make sure task is understood by everyone.) You will be given 10 minutes to discuss the problem and arrive at a group ranking."

Solution:

City	Rank
Wilmington, Delaware	6
Fall River, Massachusetts	5
Erie, Pennsylvania	4
Houston, Texas	1
Birmingham, Alabama	2
Hartford, Connecticut	3

Criteria: Correlation of group ranking with true ranking; time.

Source: Gaier & Bass, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.88	2.46
Decision verifiability	7.32	0.86
Difficulty	2.50	3.43
Goal clarity	7.32	0.88
Goal path multiplicity	1.95	2.73
Intellectual-manipulative requirements	6.81	1.64
Intrinsic interest	2.28	2.90
Operational requirements	1.19	1.79
Population familiarity	3.75	3.87
Solution multiplicity	0.88	1.58

*****

Task 85

Materials: An adequate supply of rating sheets with the following information:

Words	Rank
Uncle	
Kennel	____
Effort	____
Money	____
Village	____
	____

Instructions: "Your task is to rank the words on your problem sheet in order of familiarity. Give a rank of 1 to the word that you think is most familiar to persons in this country (i.e., most common), a rank of 2 to the word that is next most familiar, etc. First, each of you will rank the words individually. Then you will work together as a group and arrive at a group ranking of the words. Work as quickly and as accurately as you can."

Solution:

Words	True Rank
Money	1
Uncle	2
Effort	3
Village	4
Kennel	5

Criteria: Difference between the correlation of the average individual rank with true ranks and the correlation of group ranking with true ranks. Time required for group ranking.

Source: Bass, 1958.

Dimension	Scale value	Q value
Cooperation requirements	3.15	2.57
Decision verifiability	6.29	3.15
Difficulty	1.89	2.94
Goal clarity	7.21	1.70
Goal path multiplicity	1.83	2.80
Intellectual-manipulative requirements	6.95	1.80
Intrinsic interest	2.35	3.02
Operational requirements	1.45	2.07
Population familiarity	2.86	3.58
Solution multiplicity	0.98	2.00

*****

Task 86

Materials: An adequate supply of ranking sheets with the following information:

Words	Rank
Tartan	
Vertex	____
Nimbus	____
Capstan	____
Endive	____

Instructions: "Your task is to rank the words on your problem sheet in order of familiarity. Give a rank of 1 to the word that you think is most familiar to persons in this country (i.e., most common), a rank of 2 to the word that is next most familiar, etc. First, each of you will rank the words individually. Then you will work together as a group to arrive at a group ranking of the words. Work as quickly and as accurately as you can."

Solution:

Words	True Rank
Vertex	1
Tartan	2
Endive	3
Nimbus	4
Capstan	5

Criteria: Difference between the average correlation of individual rankings with true ranks and the correlation of the group ranking with true ranks. Time required for the group ranking.

Source: Bass, 1958.

Dimension	Scale value	Q value
Cooperation requirements	3.06	2.57
Decision verifiability	6.29	3.15
Difficulty	2.90	3.33
Goal clarity	7.21	1.70
Goal path multiplicity	1.83	2.80
Intellectual-manipulative requirements	6.95	1.80
Intrinsic interest	2.39	2.96
Operational requirements	1.61	2.24
Population familiarity	3.08	3.64
Solution multiplicity	0.98	1.84

*****

Task 87

Materials: An adequate supply of ranking sheets with the following information:

Words	Rank
Leader	
Zebra	____
Income	____
Youngster	____
Region	____
	____

Instructions: "Your task is to rank the words on your problem sheet in order of familiarity. Give a rank of 1 to the word that you think is most familiar to persons in this country (i.e., the most common), a rank of 2 to the next most familiar word, etc. First, each of you will rank the words individually, then you will work together as a group to arrive at a group ranking of the words. Work as quickly and as accurately as you can."

Solution:

Words	True Rank
Leader	1
Income	2
Youngster	3
Region	4
Zebra	5

Criteria: Difference between the average correlation of individual rankings with true ranks and the correlation of the group ranking with true ranks. Time required for group ranking.

Source: Bass, 1958.

Dimension	Scale value	Q value
Cooperation requirements	3.06	2.71
Decision verifiability	6.29	3.15
Difficulty	2.10	2.84
Goal clarity	7.18	1.72
Goal path multiplicity	1.75	2.80
Intellectual-manipulative requirements	6.85	1.85
Intrinsic interest	2.35	3.02
Operational requirements	1.39	2.10
Population familiarity	3.08	3.64
Solution multiplicity	1.04	1.47

*****

Task 88

Materials: An adequate supply of ranking sheets with the following information:

Words	Rank
Icon	
Meardon	____
Delphin	____
Brugen	____
Stoma	____
	____

Instructions: "Your task is to rank the words on your problem sheet in order of familiarity. Give a rank of 1 to the word that you think is most familiar to persons in this country (i.e., most common), a rank of 2 to the next most familiar, etc. First, each of you will rank the words individually. Then you will work together as a group to arrive at a group ranking of the words. Work as quickly and as accurately as you can."

Solution:

Words	True Rank
Icon	1
Stoma	2
Brugen	3
Delphin	4
Meardon	5

Criteria: Difference between the average correlation of the individual rankings with true ranks and the correlation of the group ranking with true ranks. Time required for group ranking.

Source: Bass, 1958. (Cf. Bass, Pryer, Gaier, & Flint, 1958)

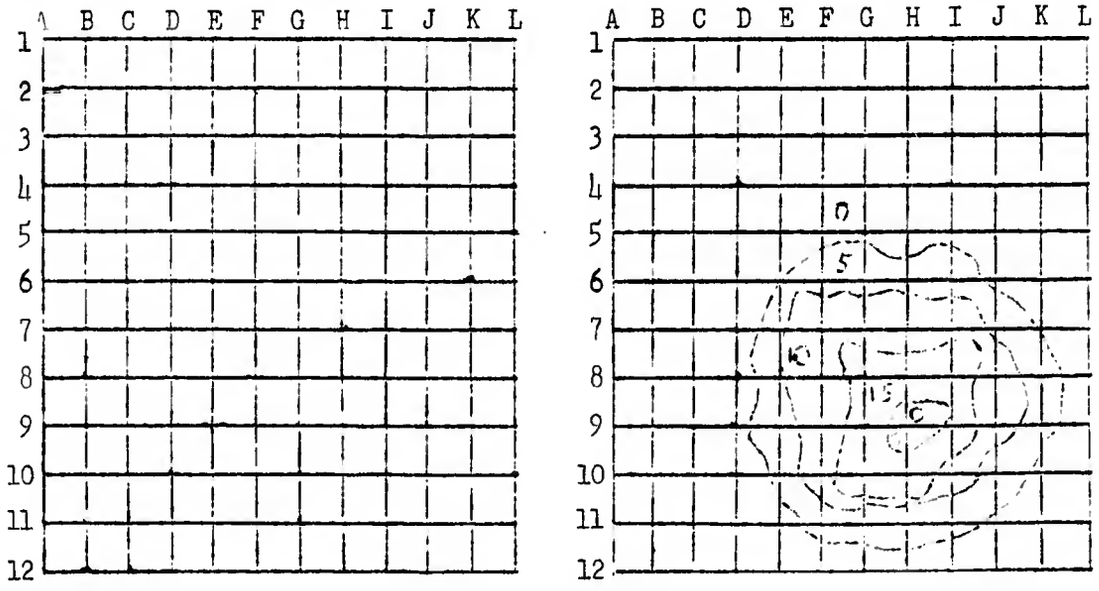
Dimension	Scale value	Q value
Cooperation requirements	3.06	2.57
Decision verifiability	6.29	3.11
Difficulty	3.05	3.64
Goal clarity	7.18	1.86
Goal path multiplicity	1.77	2.75
Intellectual-manipulative requirements	6.85	1.85
Intrinsic interest	2.32	2.71
Operational requirements	1.61	2.33
Population familiarity	2.88	3.48
Solution multiplicity	1.04	1.40

*****

Target Search Tasks

Task 89

Materials: A diagram like the one shown below (left) which can be displayed before the group, and a similar diagram (shown below, right) with target values written in for use by experimenter in reporting scores to group.



Instructions: (The diagram shown above, left, is shown to the group.) "This is a kind of search task. On each trial, you will choose one of the coordinates on this chart, e.g., D-5, E-10, etc. For each problem, I will have a chart with concentric, irregular lines drawn on it, like this (a diagram similar to the one shown above, right, is displayed to the group). The value of

your decision will be determined by the value of this diagram. For example, if you choose D-3, this coordinate is outside the largest circle and has a value of zero; if you choose a coordinate between the largest and next largest circle, you get a value of 5, etc. The object is to earn as high a score as possible on the 10 trials allowed on each problem. After each decision, I will tell you the score you have earned according to my diagram. At first, of course, you will have no basis for making a choice. However, after a few trials, you should begin to learn something about the diagram that I have, and thus be able to make more intelligent decisions.

The decision must be a group decision. You will be allowed three minutes for discussion in making each decision. If you wish you may choose the same coordinate on successive trials. You may also mark your decisions and their value on the diagram, if you wish."

Solution: The highest possible score would of course be 200, where the group chooses the central coordinate on all 10 trials.

Criteria: Total score on 10 trials; number of trials to discover coordinate having highest value.

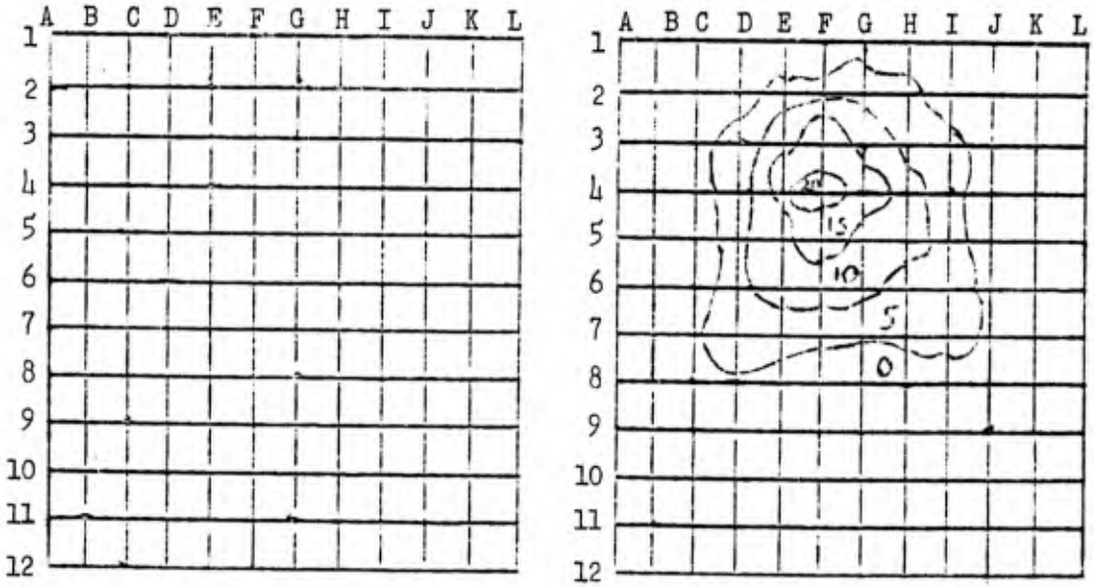
Source: Shaw, 1959.

Dimension	Scale value	Q value
Cooperation requirements	3.64	2.73
Decision verifiability	6.81	2.62
Difficulty	3.36	2.82
Goal clarity	5.38	3.17
Goal path multiplicity	3.58	3.39
Intellectual-manipulative requirements	6.21	2.53
Intrinsic interest	3.38	3.62
Operational requirements	2.50	2.17
Population familiarity	1.86	2.65
Solution multiplicity	3.46	3.03

*****

Task 90

Materials: A diagram like the one shown below (left) which can be displayed before the group, and a similar diagram (shown below, right) with target values written in for use by experimenter in reporting scores to group.



Instructions: (The diagram shown above, left, is shown to the group.) "This is a kind of search task. On each trial, you will choose one of the coordinates on this chart, e.g., D-5, E-10, etc. For each problem, I will have a chart with concentric, irregular lines drawn on it, like this (a diagram similar to the one shown above, right, is displayed to the group). The value of your decision will be determined by the value of this diagram. For example, if you choose D-3, this coordinate is outside the largest circle and has a value of zero; if you choose a coordinate between the largest and next largest circle, you get a value of 5, etc. The object is to earn as high a score as possible on the 10 trials allowed on each problem. After each decision, I will tell you the score you have earned according to my diagram. At first, of course, you will have no basis for making a choice. However, after a few trials, you should begin to learn something about the diagram that I have, and thus be able to make more intelligent decisions.

The decision must be a group decision. You will be allowed three minutes for discussion in making each decision. If you wish you may choose the same coordinate on successive trials. You may also mark your decisions and their value on the diagram, if you wish."

Solution: The highest possible score would of course b5 200, where the group chooses the central coordinate on all 10 trials.

Criteria: Total score on 10 trials; number of trials to discover coordinate having highest value.

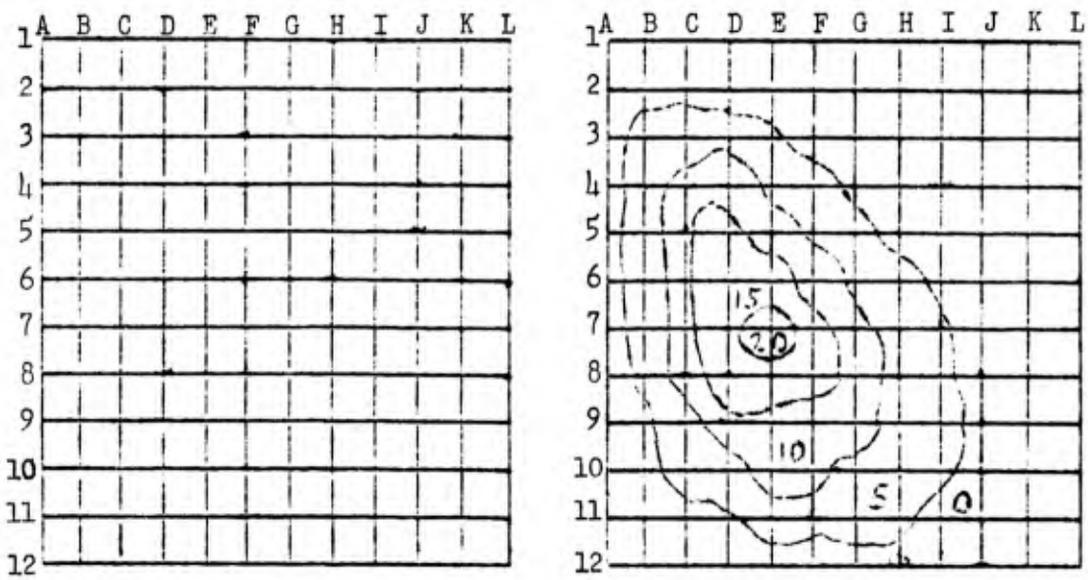
Source: Shaw, 1959.

Dimension	Scale value	Q value
Cooperation requirements	3.64	2.73
Decision verifiability	6.94	2.43
Difficulty	3.36	2.82
Goal clarity	5.38	3.47
Goal path multiplicity	3.58	3.39
Intellectual-manipulative requirements	6.21	2.62
Intrinsic interest	3.38	3.62
Operational requirements	2.50	2.17
Population familiarity	1.86	2.65
Solution multiplicity	3.38	2.94

*****

Task 91

Materials: A diagram like the one shown below (left) which can be displayed before the group, and a similar diagram (shown below, right) with target values written in for use by experimenter in reporting scores to group.



Instructions: (The diagram shown above, left, is shown to the group.) "This is a kind of search task. On each trial, you will choose one of the coordinates on this chart, e.g., D-5, E-10, etc. For each problem, I will have a chart with concentric, irregular lines drawn on it, like this (a diagram similar to the

one shown above, right, is displayed to the group). The value of your decision will be determined by the value of this diagram. For example, if you choose D-3, this coordinate is outside the largest circle and has a value of zero; if you choose a coordinate between the largest and next largest circle, you get a value of 5, etc. The object is to earn as high a score as possible on the 10 trials allowed on each problem. After each decision, I will tell you the score you have earned according to my diagram. At first, of course, you will have no basis for making a choice. However, after a few trials, you should begin to learn something about the diagram that I have, and thus be able to make more intelligent decisions.

The decision must be a group decision. You will be allowed three minutes for discussion in making each decision. If you wish you may choose the same coordinate on successive trials. You may also mark your decisions and their value on the diagram, if you wish."

Solution: The highest possible score would of course by 200, where the group chooses the central coordinate on all 10 trials.

Criteria: Total score on 10 trials; number of trials to discover coordinate having highest value.

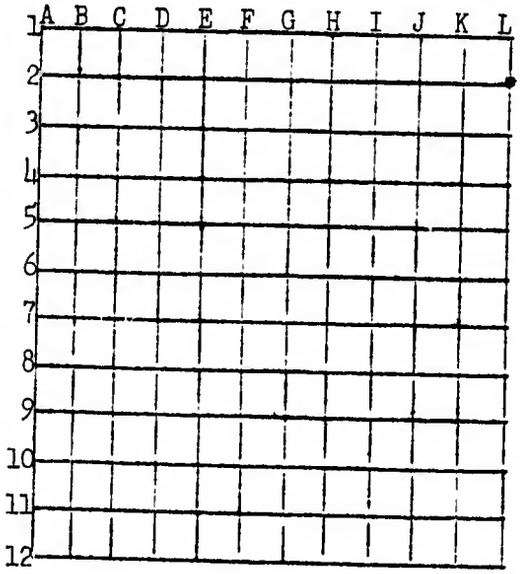
Source: Shaw, 1959.

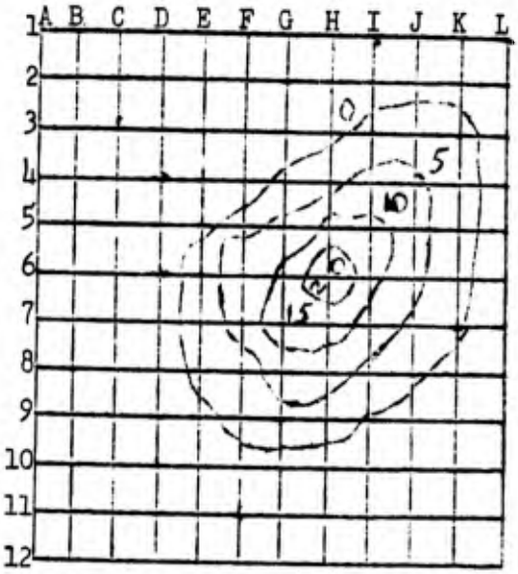
Dimension	Scale value	Q value
Cooperation requirements	3.64	2.73
Decision verifiability	6.94	2.43
Difficulty	3.25	2.76
Goal clarity	5.38	3.47
Goal path multiplicity	3.58	3.39
Intellectual-manipulative requirements	6.21	2.62
Intrinsic interest	3.38	3.62
Operational requirements	2.50	2.17
Population familiarity	1.79	2.52
Solution multiplicity	3.46	2.92

*****

Task 92

Materials: A diagram like the one shown below (left) which can be displayed before the group, and a similar diagram (shown below, right) with target values written in for use by experimenter in reporting scores to group.





Instructions: (The diagram shown above, left, is shown to the group.) "This is a kind of search task. On each trial, you will choose one of the coordinates on this chart, e.g., D-5, E-10, etc. For each problem, I will have a chart with concentric, irregular lines drawn on it, like this (a diagram similar to the one shown above, right, is displayed to the group). The value of your decision will be determined by the value on this diagram. For example, if you choose D-3, this coordinate is outside the largest circle and has a value of zero; If you choose a coordinate between the largest and next largest circle, you get a value of 5, etc. The object is to earn as high a score as possible on the 10 trials allowed on each problem. After each decision, I will tell you the score you have earned according to my diagram. At first, of course, you will have no basis for making a choice. However, after a few trials, you should begin to learn something about the diagram that I have, and thus be able to make more intelligent decisions.

The decision must be a group decision. You will be allowed three minutes for discussion in making each decision. If you wish you may choose the same coordinate on successive trials. You may also mark your decisions and their value on the diagram, if you wish."

Solution: The highest possible score would of course be 200, where the group chooses the central coordinate on all 10 trials.

Criteria: Total score on 10 trials; number of trials to discover coordinate having highest value.

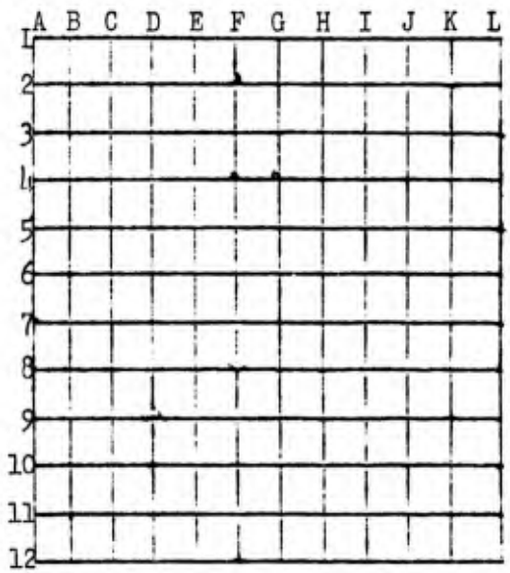
Source: Shaw, 1959.

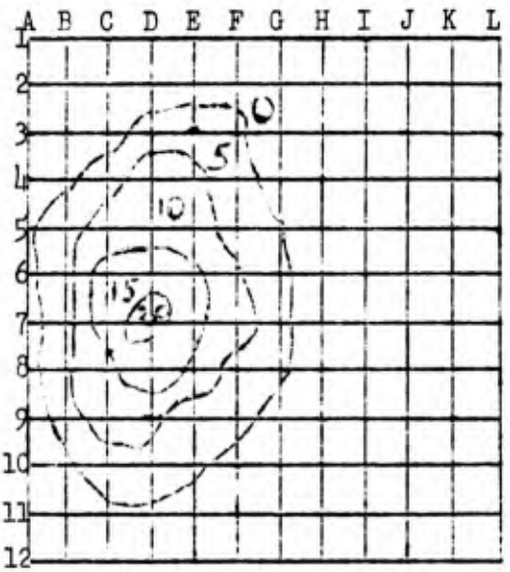
Dimension	Scale value	Q value
Cooperation requirements	3.64	2.73
Decision verifiability	6.94	2.43
Difficulty	3.36	2.76
Goal clarity	5.38	3.17
Goal path multiplicity	3.58	3.44
Intellectual-manipulative requirements	6.21	2.62
Intrinsic interest	3.38	3.62
Operational requirements	2.50	2.17
Population familiarity	1.86	2.52
Solution multiplicity	3.46	2.92

*****

Task 93

Materials: A diagram like the one shown below (left) which can be displayed before the group, and a similar diagram (shown below, right) with target values written in for use by experimenter in reporting scores to group.





Instructions: (The diagram shown above, left, is shown to the group.) "This is a kind of search task. On each trial, you will choose one of the coordinates on this chart, e.g., D-5, E-10, etc. For each problem, I will have a chart with concentric, irregular lines drawn on it, like this (a diagram similar to the one shown above, right, is displayed to the group). The value of your decision will be determined by the value on this diagram. For example, if you choose D-3, this coordinate is outside the largest circle and has a value of zero; if you choose a coordinate between the largest and next largest circle, you get a value of 5, etc. The object is to earn as high a score as possible on the 10 trials allowed on each problem. After each decision, I will tell you the score you have earned according to my diagram. At first, of course, you will have no basis for making a choice. However, after a few trials, you should begin to learn something about the diagram that I have, and thus be able to make more intelligent decisions.

The decision must be a group decision. You will be allowed three minutes for discussion in making each decision. If you wish you may choose the same coordinate on successive trials. You may also mark your decisions and their value on the diagram, if you wish."

Solution: The highest possible score would of course be 200, where the group chooses the central coordinate on all 10 trials.

Criteria: Total score on 10 trials; number of trials to discover coordinate having highest value.

Source: Shaw, 1959.

Dimension	Scale value	Q value
Cooperation requirements	3.56	2.70
Decision verifiability	6.94	2.43
Difficulty	3.25	2.76
Goal clarity	5.29	3.37
Goal path multiplicity	3.58	3.39
Intellectual-manipulative requirements	6.21	2.62
Intrinsic interest	3.38	3.62
Operational requirements	2.50	2.17
Population familiarity	1.85	2.71
Solution multiplicity	3.46	2.92

*****

Miscellaneous Tasks

Task 94

Materials: Four tables placed around the laboratory:
(a) a supplier's table with a large supply of tinker toy parts, sorted and placed in labelled boxes.
(b) a display table upon which are displayed five complete tinker toy models (a top, a man, an airplance, a wagon, and a ladder - all of simple construction),
(c) the "Shop," a large table upon which the products can be assembled, and upon which are placed pads, pencils, and order forms, and
(d) a "buyer's" table at which finished toys may be sold. Three dollars in change for the group to set itself up in business. Four itemized lists of supply costs and selling prices. (One list for each of four work periods)

Instructions: "You are a business organization which manufactures the products displayed on this table (indicating display table). Your task will be to buy parts, manufacture the products, and sell them at this table (indicating buyer's table). The object of course, is to make as large a profit as you can in the 20 minutes allotted to you. You have been provided an itemized list of supply costs and selling prices. These costs and selling prices will fluctuate every five minutes throughout the 20 minute work period. At the appropriate time, I will provide you with the new itemized list of costs and selling prices. In order to buy parts, you fill out and submit to the supplier itemized order forms, signed by each member of the group and accompanied by enough money to cover the particular order. Finished products may be sold at the buyer's table at any time that is agreeable to the group. Before you begin the work period, you will have 10 minutes to plan the operation. Are there any questions?"

Solution: Variable.

Criteria: Amount of profit or loss during the 20-minute period; judged quality of group decisions.

Source: Pepinsky, Hemphill, & Shevitz, 1958.

Dimension	Scale value	Q value
Cooperation requirements	6.25	2.00
Decision verifiability	2.86	2.59
Difficulty	4.86	2.55
Goal clarity	2.91	2.74
Goal path multiplicity	6.44	1.66
Intellectual-manipulative requirements	3.88	2.34
Intrinsic interest	4.83	3.61
Operational requirements	6.17	2.64
Population familiarity	3.88	2.70
Solution multiplicity	6.21	1.99

*****

Task 95

Materials: One 3 x 5 card for each group member, each having 5 of the following symbols:

* 0 + △ ◇ □

Each member is given one card. The symbols are distributed on the cards so that only one symbol is held in common by all group members. The task of the group is to identify the common symbol by written communication.

Instructions: "You will each be given a card upon which several symbols have been drawn. Only one symbol appears on each and every member's card. Your task is to discover the symbol held in common by all group members. You may not pass on the card to others in the group, but information about your card may be communicated by written message. The task is complete when all group members have indicated that they know the common symbol."

Solution: Identification of common symbol.

Criteria: Time (from go signal until last person knows common symbol); errors (number of Ss who identify incorrect symbol); number of messages.

Source: Leavitt, 1951.

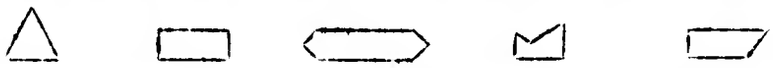
Dimension	Scale value	Q value
Cooperation requirements	6.30	1.74
Decision verifiability	7.21	2.34
Difficulty	3.28	2.96
Goal clarity	5.19	3.42
Goal path multiplicity	3.50	2.52
Intellectual-manipulative requirements	5.17	2.77
Intrinsic interest	3.25	3.05
Operational requirements	2.84	2.50
Population familiarity	2.06	2.74
Solution multiplicity	0.63	0,62

*****

Task 96

Materials: Fifteen variform cardboard pieces that can be arranged in such a way as to form 5 squares, as shown below, plus 2 pieces that do not fit any square.

Additional cardboard pieces: 15 matching the ones listed above plus 5 pieces like those drawn below:



These pieces are white on one side and black on the other.

A tray divided into two sections to be used as a communication device. (Note: The pieces to be used in making squares are randomly distributed among members of the group; the two extra pieces are placed in front section of tray.)

Instructions: "This is a group problem solving situation with a group goal. All members of the group will work on a common problem, but the only communication among group members will be via the experimenter who will serve as a messenger. The group task is to assemble five squares from a set of cardboard pieces, such as these. (Show examples.) Each person's part is to assemble one square, but the group goal is not achieved until all five squares have been assembled. There are numerous ways in which one or several squares can be assembled from the available pieces, but there are very few ways in which all five squares can be assembled.

Each of you will start off with the pieces that I have given you. From time to time, the experimenter (moving in a clockwise direction) will present you with a tray which is divided into two sections. In the front section are exchange pieces. There will always to two pieces there; if you wish to exchange a piece you have for one on the tray, you simply make the exchange. The back part of the tray is to enable you to request pieces you would like to have from others in the group. The black pieces represent all the kinds that make up the original set. You may request a piece by turning it over and exposing the white side. These pieces cannot be exchanged, but are used only for requesting other pieces. Each time the tray is presented, you may either pass, exchange one piece, request one piece, or exchange one piece and request one piece. The experimenter will continue to circulate until all five squares have been assembled."

Solution: Assembly of five squares as shown above.

Criteria: Number of rounds required (tray rotations); time required; number of squares correctly assembled (if time limit imposed).

Source: Crutchfield, 1951. (Cf. Bavelas, 1950)

Dimension	Scale value	Q value
Cooperation requirements	5.88	2.09
Decision verifiability	7.18	1.58
Difficulty	5.44	3.59
Goal clarity	3.30	3.65
Goal path multiplicity	4.32	2.32
Intellectual-manipulative requirements	2.62	2.14
Intrinsic interest	3.73	2.78
Operational requirements	4.25	3.57
Population familiarity	2.94	2.98
Solution multiplicity	1.21	1.83

*****

Task 97

Materials: Paper and pencils. Copy of the following statement:

"A certain college had a square dormitory that had eight rooms on each floor, as shown in the diagram below:

*Stairs

Lower floor Upper floor

The dean of the college stipulated that students be assigned to this dormitory so that there are exactly 11 persons sleeping on each side of the building, and twice as many on the upper floor as on the lower floor. Furthermore, every room must be occupied, and no more than 3 persons may occupy the same room.

After the housing director learned the number of students to be assigned to the dormitory, he had no difficulty working out room assignments meeting the dean's conditions. When the students arrived, however, he found that there were three more than expected. Nevertheless, he succeeded in getting them all into the dormitory without breaking the dean's rules. How many students were expected, how many actually appeared, and what was the room assignment in each case?

Instructions: "This is a group task. You may attack it in any way that you wish as long as you work together as a group. The task will be terminated when you have answered the three questions posed in the problem statement, or when 20 minutes have elapsed, whichever comes first."

Solution:

Number Expected: 27
Assignments:

3	1	3
1		2
3	2	3

Upper

2	1	1
1		1
1	1	1

Lower

Number Arrived: 30
Assignments:

2	3	3
3		2
3	2	2

Upper

1	1	1
1		2
1	2	1

Lower

Criteria: Number of questions answered correctly; time.

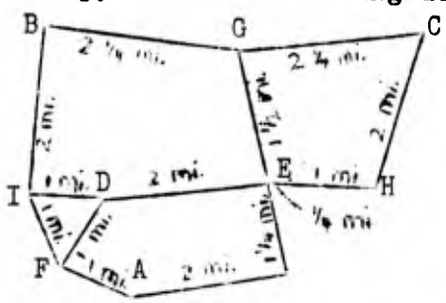
Source: (old parlor game)

Dimension	Scale value	Q value
Cooperation requirements	2.86	2.56
Decision verifiability	7.21	2.34
Difficulty	6.09	2.32
Goal clarity	4.07	3.30
Goal path multiplicity	2.96	2.73
Intellectual-manipulative requirements	6.14	2.96
Intrinsic interest	3.45	2.95
Operational requirements	4.12	2.82
Population familiarity	3.59	2.68
Solution multiplicity	0.88	2.42

*****

Task 98

Materials: A copy of the following diagram:



Paper and pencils. A copy of the following instructions for each group member:

Instructions: "A consolidated school is to be built in the rural district shown in the diagram. The capital letters (A, B, C, etc.) indicate points (not towns) where pupils are to be picked up by two school buses. The mileage between each point is indicated on the diagram. The capacity of each bus is 35 pupils and the driver. Find the most desirable location for the school and give the route each bus must take. The buses may start at ANY point and need not necessarily start from the school each morning. Following are the number of pupils to be picked up at each point:

Point:	A	B	C	D	E	F	G	H	I
No. Pupils:	6	13	17	4	2	5	3	10	3

This is a group task. Work together cooperatively to solve the problem as accurately and as quickly as possible."

Solution: Locate school at point G.
Bus No. 1 leaves point C picking up 17 pupils, thence to Point H for 10 pupils, to Point E for 2 pupils, to Point G and school, for a total of 3 3/4 miles.
Bus No. 2 leaves from Point A with 6 pupils, to Point F for 5, to Point D for 4, to Point I for 3, to Point B for 13, to School, for a total of 7 1/4 miles.
(Three pupils pick-up point at school. Total bus mileage is 12.) (NOTE: School can be anywhere between Point B and G, if Bus 1 picks up pupils at Point G.)

Criteria: Time; school location error: distance from best location; excess mileage buses travel.

Source: Shaw, Marjorie E., 1932 (Cf. Marquart, 1955)

Dimension	Scale value	Q value
Cooperation requirements	2.79	2.23
Decision verifiability	6.46	2.28
Difficulty	5.35	2.81
Goal clarity	4.58	3.37
Goal path multiplicity	3.55	2.46
Intellectual-manipulative requirements	5.56	2.43
Intrinsic interest	3.06	2.41
Operational requirements	4.35	2.44
Population familiarity	4.15	2.60
Solution multiplicity	2.06	2.53

*****

Task 99

Materials: A list of words, such as "wrench," "ruby," "bread," etc.

Instructions: "I have here a list of several common objects. On each trial I will select one of these objects and identify it as either animal, vegetable or mineral. Your task is to identify the object by asking a series of questions. In reply to each question posed by a group member, I will answer in one of the following ways" (a) Yes, (b) No, (C) Partly, (d) Not in the usual sense of the word, (e) Sometimes, (f) I don't know (in which case there will be no charge for the question), or (g) Please restate the question (in case the question is unclear or cannot be answered in any one of the above ways). You may ask

questions in any order that is agreeable to the group. If you have not identified the object after asking 40 questions, we will go on to the next trial. Are there any questions?"

Solution: Identification of object.

Criteria: Average number of questions required to identify; number of objects identified on 5 trials.

Source: Smith, 1957.

Dimension	Scale value	Q value
Cooperation requirements	3.81	2.80
Decision verifiability	6.78	2.08
Difficulty	2.68	2.83
Goal clarity	5.94	2.85
Goal path multiplicity	5.28	2.56
Intellectual-manipulative requirements	7.34	0.66
Intrinsic interest	5.81	2.76
Operational requirements	4.50	3.62
Population familiarity	5.65	3.35
Solution multiplicity	0.91	3.10

*****

Task 100

Materials: Paper and pencils. Three crypts:

1. ORST PILY NOHY RTSA CUEC
2. MITSIENURN INUOGSCKT
3. PSCLST
   YHOTEH
   OGSNEA
   IODSNS
   FOTGTO
   TREWRK

Copies (one for each S) of the following instructions:

Instructions: "We are interested in observing how individuals work together to solve problems. In this situation, you are asked to work together to solve crypts. Cryptography is the art of secret writing. In it, one word or letter or number is substituted for another, or the words are scrambled in such a fashion that they are unreadable. Here are several examples: (a) The letters of the alphabet are reversed so that Z stands for A, Y for B, X for C, and so on. Thus the word class is written xozhh. (b) The letters are written in couplets; then one writes out the first of each pair, then the second. For example, pencil would be pniecl. To break this code, one simply divides the letters in half, writes the first half with wide spaces between them, writes the second half below with letters corresponding to spaces above,

and combines the two. (c) Another method takes the first, then the second, then the third, and so on, letters of each word. E.g., Are you here becomes ayhroeeure. (d) A final procedure is called the Horizontal or Vertical Route Transposition Code. First, the message is written in a series of horizontal columns; then select the letters in some mixed up manner. E.g., This is really very easy might be done in this manner:

thisi
sreal
lyver
yeasy

The final code then may be written tsly eyrh ieva seas ilry.

You may divide the work up any way you wish and feel free to discuss and talk freely. You will be given three coded messages to unscramble. You will have five minutes to work on each code."

Solution:
Crypt 1. Can you solve this crypt.
Crypt 2. Time is running out.
Crypt 3. Psychologists often do the strangest work.

Criteria: Number of words correctly decoded; number of crypts correctly decoded; mean time required per crypt.

Source: Cattell & Stice, 1960.

Dimension	Scale value	Q value
Cooperation requirements	2.94	2.52
Decision verifiability	6.82	1.52
Difficulty	5.95	3.04
Goal clarity	5.25	3.93
Goal path multiplicity	3.45	3.41
Intellectual-manipulative requirements	5.81	2.36
Intrinsic interest	4.88	2.63
Operational requirements	5.41	2.69
Population familiarity	2.29	2.66
Solution multiplicity	0.79	1.46

*****

Task 101

Materials: Paper and pencils. Three crypts, as follows:
1. TEHSYKSILBEU
2. LLASREUQNOCEVOL
3. ERAWEBHTEGOD

Copies (one for each S) of the following instructions:

Instructions: "We are interested in observing how individuals work together to solve problems. In this situation, you are asked to work together to solve crypts. Cryptography is the art of secret writing. In it, one word or letter or number is substituted for another, or the words are scrambled in such a fashion that

they are unreadable. Here are several examples: (a) The letters of the alphabet are reversed so that Z stands for A, Y for B, X for C, and so on. Thus the word class is written xozhh. (b) The letters are written in couplets; then one writes out the first of each pair, then the second. For example, pencil would be pniecl. To break this code, one simply divides the letters in half, writes the first half with wide spaces between them, writes the second half below with letters corresponding to spaces above, and combines the two. (c) Another method takes the first, then the second, then the third, and so on, letters of each word. E.g., Are you here becomes ayhroeeure. (d) A final procedure is called the Horizontal or Vertical Route Transposition Code. First, the message is written in a series of horizontal columns; then select the letters in some mixed up manner. E.g., This is really very easy might be done in this manner:

thisi
sreal
lyver
yeasy

The final code then may be written tsly eyrh ieva seas ilry.

You may divide the work up any way you wish and feel free to discuss and talk freely. You will be given three coded messages to unscramble. You will have five minutes to work on each code."

Solution:
Crypt 1. The sky is blue.
Crypt 2. Love conquers all.
Crypt 3. Beware the dog.

Criteria: Number of words correctly decoded; number of crypts correctly decoded; mean time required per crypt.

Source: Cattell & Stice, 1960.

Dimension	Scale value	Q value
Cooperation requirements	2.94	2.93
Decision verifiability	6.77	1.50
Difficulty	5.77	2.74
Goal clarity	5.10	3.94
Goal path multiplicity	3.35	3.41
Intellectual-manipulative requirements	5.93	2.37
Intrinsic interest	4.95	2.63
Operational requirements	5.32	2.28
Population familiarity	2.32	2.71
Solution multiplicity	0.79	1.46

*****

Task 102

Materials: A copy of the following unfinished sonnet:

"Knowing this man, who calls himself comrade,
mean, underhanded, lacking all attributes
real men desire, that replenish all worlds
men strive for, knowing that charlatan, fool too
masquerading always in our colors, must also
be addressed as comrade - knowing these and
others to be false, deficient in knowledge
and love for fellow man that motivates our kind.
Nevertheless I answer the salutation proudly,
equally sure that no one can defile it,
feeling deeper than the word the love it bears,"

A number of cards, each having one of the following words typed on it: "The world it builds and no man lying talking behind back betraying trusting friend is worth enough to soil this word or mar this world"

Four cards each having a comma printed on it, and one card having a period printed on it.

Instructions: "The purpose of this task is to determine how people work together on a problem requiring verbal skill. Your task, as a group, is to rearrange the words and punctuation marks you have been given so that they form the last three lines to the unfinished sonnet on your problem sheet. Work as quickly and as accurately as you can."

Solution:

the world it builds, and no man lying,
talking behind back, betraying trusting friend,
is worth enough to soil this word or mar this world.

Criteria: Number of words and punctuation marks in correct order; time required.

Source: Marquart, 1955.

Dimension	Scale value	Q value
Cooperation requirements	3.62	2.34
Decision verifiability	5.50	3.35
Difficulty	5.93	3.00
Goal clarity	4.39	3.31
Goal path multiplicity	3.56	2.32
Intellectual-manipulative requirements	5.72	1.97
Intrinsic interest	3.61	3.14
Operational requirements	4.06	2.37
Population familiarity	2.39	3.31
Solution multiplicity	1.15	2.09

*****

Task 103

Materials: Slide projector and screen; 10 slides having the following numbers of black dots on a white ground: 692, 292, 300, 1190, 2223, 445, 876, 168, 1326, and 745.

Instructions: "We are interested in determining how accurately a group of individuals can estimate the number of items displayed upon a homogeneous field. On each trial, a slide having a large number of dots on it will be projected on the screen. The exposure time (5 sec.) will be too brief for you to count the dots, but you should be able to get a general impression of the number of dots on any given slide. When I say, "Ready," look at the screen. After the slide has been exposed, you will have three minutes to discuss and to decide among yourselves how many dots there were. When you have decided, give me the group estimate and we will go on to the next slide. Your score will be determined by the degree to which your estimate approximates the actual number of dots on each slide."

Solution: Correct estimate of number of dots.

Criteria: Mean error (number of dots minus number estimated, without regard to direction); mean time per decision.

Source: Goldberg, 1955. (Cf. Exline & Ziller, 1959)

Dimension	Scale value	Q value
Cooperation requirements	2.65	3.07
Decision verifiability	7.09	5.68
Difficulty	2.94	2.53
Goal clarity	7.18	3.04
Goal path multiplicity	2.69	3.43
Intellectual-manipulative requirements	6.50	3.38
Intrinsic interest	2.21	3.14
Operational requirements	0.91	2.68
Population familiarity	2.15	2.52
Solution multiplicity	1.42	2.15

*****

Task 104

Materials: Slide projector and screen; ten slides having the following numbers of black dots on a white background: 692, 292, 300, 1190, 2223, 455, 876, 163, 1426, and 745; and 10 response sheets, one for each slide respectively, as follows:

a. 592	a. 292	a. 200	a. 1190	a. 1850	a. 355	a. 876	a. 100
b. 692	b. 351	b. 250	b. 1300	b. 2008	b. 455	b. 935	b. 91
c. 792	c. 326	c. 300	c. 1491	c. 2223	c. 555	c.1042	c. 168

a. 1896	a. 1002
b. 1632	b. 853
c. 1426	c. 745

Instructions: "We are interested in determining how accurately a group of individuals can estimate the number of items displayed upon a homogeneous field. On each trial, a slide having a large number of dots will be projected on the screen. The exposure time (5 sec.) will be too brief for you to count the dots, but you should be able to get an impression from the flash which will enable you to choose the correct number from three alternatives which will be indicated on each answer sheet. When I say, "Ready," look at the screen. After each slide has been exposed, you will have three minutes to discuss and decide among yourselves which of the three alternatives is the correct one. When you have decided, mark your answer on the answer sheet by circling the alternative you have chosen and hand the answer sheet to me. Then we will go on to the next trial. Your score will be the number of correct alternatives chosen."

Solution: Alternatives b, a, c, a, c, b, a, c, c, c

Criteria: Number of correct alternatives chosen on ten trials; mean time per decision.

Source: Goldberg, 1955.

Dimension	Scale value	Q value
Cooperation requirements	2.54	2.66
Decision verifiability	7.00	5.68
Difficulty	2.83	2.66
Goal clarity	7.16	3.00
Goal path multiplicity	2.35	2.70
Intellectual-manipulative requirements	6.50	3.37
Intrinsic interest	2.32	3.01
Operational requirements	0.84	2.56
Population familiarity	2.23	2.43
Solution multiplicity	0.98	1.31

*****

UNCLASSIFIED