

# PSYCHOLOGICAL REVIEW

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## ASSETS AND LIABILITIES IN GROUP PROBLEM SOLVING:

### THE NEED FOR AN INTEGRATIVE FUNCTION<sup>1</sup>

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Research on group problem solving reveals that the group has both advantages and disadvantages over individual problem solving. If the potentials for group problem solving can be exploited and if its deficiencies can be avoided, it follows that group problem solving can attain a level of proficiency not ordinarily achieved. The requirement for achieving this level of group performance seems to hinge on developing a style of discussion leadership which maximizes the group's assets and minimizes its liabilities. Since members possess the essential ingredients for the solutions, the deficiencies that appear in group solutions reside in the processes by which group solutions develop. These processes can determine whether the group functions effectively or ineffectively. The critical factor in a group's potential is organization and integration. With training, a leader can supply these functions and serve as the group's central nervous system, thus permitting the group to emerge as a highly efficient entity.

A number of investigations have raised the question of whether group problem solving is superior, inferior, or equal to individual problem solving. Evidence can be cited in support of each position so that the answer to this question remains ambiguous. Rather than pursue this generalized approach to the question, it seems more fruitful to explore the forces that influence problem solving under the two conditions (see reviews by Hoffman, 1965; Kelley & Thibaut, 1954). It is

hoped that a better recognition of these forces will permit clarification of the varied dimensions of the problem-solving process, especially in groups.

The forces operating in such groups include some that are assets, some that are liabilities, and some that can be either assets or liabilities, depending upon the skills of the members, especially those of the discussion leader. Let us examine these three sets of forces.

#### GROUP ASSETS

##### *Greater Sum Total of Knowledge and Information*

There is more information in a group than in any of its members. Thus

<sup>1</sup>The research reported here was supported by Grant No. MH-02704 from the United States Public Health Service. Grateful acknowledgment is made for the constructive criticism of Melba Colgrove, Junie Janzen, Mara Julius, and James Thurber.

problems that require the utilization of knowledge should give groups an advantage over individuals. Even if one member of the group (e.g., the leader) knows much more than anyone else, the limited unique knowledge of lesser-informed individuals could serve to fill in some gaps in knowledge. For example, a skilled machinist might contribute to an engineer's problem solving and an ordinary workman might supply information on how a new machine might be received by workers.

*Greater Number of Approaches to a Problem*

It has been shown that individuals get into ruts in their thinking (Duncker, 1945; Maier, 1930; Wertheimer, 1959). Many obstacles stand in the way of achieving a goal, and a solution must circumvent these. The individual is handicapped in that he tends to persist in his approach and thus fails to find another approach that might solve the problem in a simpler manner. Individuals in a group have the same failing, but the approaches in which they are persisting may be different. For example, one researcher may try to prevent the spread of a disease by making man immune to the germ, another by finding and destroying the carrier of the germ, and still another by altering the environment so as to kill the germ before it reaches man. There is no way of determining which approach will best achieve the desired goal, but undue persistence in any one will stifle new discoveries. Since group members do not have identical approaches, each can contribute by knocking others out of ruts in thinking.

*Participation in Problem Solving Increases Acceptance*

Many problems require solutions that depend upon the support of others to

be effective. Insofar as group problem solving permits participation and influence, it follows that more individuals accept solutions when a group solves the problem than when one person solves it. When one individual solves a problem he still has the task of persuading others. It follows, therefore, that when groups solve such problems, a greater number of persons accept and feel responsible for making the solution work. A low-quality solution that has good acceptance can be more effective than a higher-quality solution that lacks acceptance.

*Better Comprehension of the Decision*

Decisions made by an individual, which are to be carried out by others, must be communicated from the decision-maker to the decision-executors. Thus individual problem solving often requires an additional stage—that of relaying the decision reached. Failures in this communication process detract from the merits of the decision and can even cause its failure or create a problem of greater magnitude than the initial problem that was solved. Many organizational problems can be traced to inadequate communication of decisions made by superiors and transmitted to subordinates, who have the task of implementing the decision.

The chances for communication failures are greatly reduced when the individuals who must work together in executing the decision have participated in making it. They not only understand the solution because they saw it develop, but they are also aware of the several other alternatives that were considered and the reasons why they were discarded. The common assumption that decisions supplied by superiors are arbitrarily reached therefore disappears. A full knowledge of goals, obstacles, alternatives, and factual information is essential to communica-

tion, and this communication is maximized when the total problem-solving process is shared.

#### GROUP LIABILITIES

##### *Social Pressure*

Social pressure is a major force making for conformity. The desire to be a good group member and to be accepted tends to silence disagreement and favors consensus. Majority opinions tend to be accepted regardless of whether or not their objective quality is logically and scientifically sound. Problems requiring solutions based upon facts, regardless of feelings and wishes, can suffer in group problem-solving situations.

It has been shown (Maier & Solem, 1952) that minority opinions in leaderless groups have little influence on the solution reached, even when these opinions are the correct ones. Reaching agreement in a group often is confused with finding the right answer, and it is for this reason that the dimensions of a decision's acceptance and its objective quality must be distinguished (Maier, 1963).

##### *Valence of Solutions*

When leaderless groups (made up of three or four persons) engage in problem solving, they propose a variety of solutions. Each solution may receive both critical and supportive comments, as well as descriptive and explorative comments from other participants. If the number of negative and positive comments for each solution are algebraically summed, each may be given a *valence index* (Hoffman & Maier, 1964). The first solution that receives a positive valence value of 15 tends to be adopted to the satisfaction of all participants about 85% of the time, regardless of its quality. Higher quality solutions intro-

duced after the critical value for one of the solutions has been reached have little chance of achieving real consideration. Once some degree of consensus is reached, the jelling process seems to proceed rather rapidly.

The critical valence value of 15 appears not to be greatly altered by the nature of the problem or the exact size of the group. Rather, it seems to designate a turning point between the idea-getting process and the decision-making process (idea evaluation). A solution's valence index is not a measure of the number of persons supporting the solution, since a vocal minority can build up a solution's valence by actively pushing it. In this sense, valence becomes an influence in addition to social pressure in determining an outcome.

Since a solution's valence is independent of its objective quality, this group factor becomes an important liability in group problem solving, even when the value of a decision depends upon objective criteria (facts and logic). It becomes a means whereby skilled manipulators can have more influence over the group process than their proportion of membership deserves.

##### *Individual Domination*

In most leaderless groups a dominant individual emerges and captures more than his share of influence on the outcome. He can achieve this end through a greater degree of participation (valence), persuasive ability, or stubborn persistence (fatiguing the opposition). None of these factors is related to problem-solving ability, so that the best problem solver in the group may not have the influence to upgrade the quality of the group's solution (which he would have had if left to solve the problem by himself).

Hoffman and Maier (1967) found that the mere fact of appointing a leader causes this person to dominate a discussion. Thus, regardless of his problem-solving ability a leader tends to exert a major influence on the outcome of a discussion.

*Conflicting Secondary Goal: Winning the Argument*

When groups are confronted with a problem, the initial goal is to obtain a solution. However, the appearance of several alternatives causes individuals to have preferences and once these emerge the desire to support a position is created. Converting those with neutral viewpoints and refuting those with opposed viewpoints now enters into the problem-solving process. More and more the goal becomes that of winning the decision rather than finding the best solution. This new goal is unrelated to the quality of the problem's solution and therefore can result in lowering the quality of the decision (Hoffman & Maier, 1966).

FACTORS THAT SERVE AS ASSETS OR LIABILITIES, DEPENDING LARGELY UPON THE SKILL OF THE DISCUSSION LEADER

*Disagreement*

The fact that discussion may lead to disagreement can serve either to create hard feelings among members or lead to a resolution of conflict and hence to an innovative solution (Hoffman, 1961; Hoffman, Harburg, & Maier, 1962; Hoffman & Maier, 1961; Maier, 1958, 1963; Maier & Hoffman, 1965). The first of these outcomes of disagreement is a liability, especially with regard to the acceptance of solutions; while the second is an asset, particularly where innovation is desired. A leader can treat disagreement as un-

desirable and thereby reduce the probability of both hard feelings and innovation, or he can maximize disagreement and risk hard feelings in his attempts to achieve innovation. The skill of a leader requires his ability to create a climate for disagreement which will permit innovation without risking hard feelings. The leader's perception of disagreement is one of the critical factors in this skill area (Maier & Hoffman, 1965). Others involve permissiveness (Maier, 1953), delaying the reaching of a solution (Maier & Hoffman, 1960b; Maier & Solem, 1962), techniques for processing information and opinions (Maier, 1963; Maier & Hoffman, 1960a; Maier & Maier, 1957), and techniques for separating idea-getting from idea-evaluation (Maier, 1960, 1963; Osborn, 1953).

*Conflicting Interests versus Mutual Interests*

Disagreement in discussion may take many forms. Often participants disagree with one another with regard to solutions, but when issues are explored one finds that these conflicting solutions are designed to solve different problems. Before one can rightly expect agreement on a solution, there should be agreement on the nature of the problem. Even before this, there should be agreement on the goal, as well as on the various obstacles that prevent the goal from being reached. Once distinctions are made between goals, obstacles, and solutions (which represent ways of overcoming obstacles), one finds increased opportunities for cooperative problem solving and less conflict (Hoffman & Maier, 1959; Maier, 1960, 1963; Maier & Solem, 1962; Solem, 1965).

Often there is also disagreement regarding whether the objective of a solution is to achieve quality or accept-

ance (Maier & Hoffman, 1964b), and frequently a stated problem reveals a complex of separate problems, each having separate solutions so that a search for a single solution is impossible (Maier, 1963). Communications often are inadequate because the discussion is not synchronized and each person is engaged in discussing a different aspect. Organizing discussion to synchronize the exploration of different aspects of the problem and to follow a systematic procedure increases solution quality (Maier & Hoffman, 1960a; Maier & Maier, 1957). The leadership function of influencing discussion procedure is quite distinct from the function of evaluating or contributing ideas (Maier, 1950, 1953).

When the discussion leader aids in the separation of the several aspects of the problem-solving process and delays the solution-mindedness of the group (Maier, 1958, 1963; Maier & Solem, 1962), both solution quality and acceptance improve; when he hinders or fails to facilitate the isolation of these varied processes, he risks a deterioration in the group process (Solem, 1965). His skill thus determines whether a discussion drifts toward conflicting interests or whether mutual interests are located. Cooperative problem solving can only occur after the mutual interests have been established and it is surprising how often they can be found when the discussion leader makes this his task (Maier, 1952, 1963; Maier & Hayes, 1962).

### *Risk Taking*

Groups are more willing than individuals to reach decisions involving risks (Wallach & Kogan, 1965; Wallach, Kogan, & Bem, 1962). Taking risks is a factor in acceptance of change, but change may either represent a gain or a loss. The best guard

against the latter outcome seems to be primarily a matter of a decision's quality. In a group situation this depends upon the leader's skill in utilizing the factors that represent group assets and avoiding those that make for liabilities.

### *Time Requirements*

In general, more time is required for a group to reach a decision than for a single individual to reach one. Insofar as some problems require quick decisions, individual decisions are favored. In other situations acceptance and quality are requirements, but excessive time without sufficient returns also represents a loss. On the other hand, discussion can resolve conflicts, whereas reaching consensus has limited value (Wallach & Kogan, 1965). The practice of hastening a meeting can prevent full discussion, but failure to move a discussion forward can lead to boredom and fatigue-type solutions, in which members agree merely to get out of the meeting. The effective utilization of discussion time (a delicate balance between permissiveness and control on the part of the leader), therefore, is needed to make the time factor an asset rather than a liability. Unskilled leaders tend to be too concerned with reaching a solution and therefore terminate a discussion before the group potential is achieved (Maier & Hoffman, 1960b).

### *Who Changes*

In reaching consensus or agreement, some members of a group must change. Persuasive forces do not operate in individual problem solving in the same way they operate in a group situation; hence, the changing of someone's mind is not an issue. In group situations, however, who changes can be an asset or a liability. If persons with the most constructive views are induced to change

the end-product suffers; whereas if persons with the least constructive points of view change the end-product is upgraded. The leader can upgrade the quality of a decision because his position permits him to protect the person with a minority view and increase his opportunity to influence the majority position. This protection is a constructive factor because a minority viewpoint influences only when facts favor it (Maier, 1950, 1952; Maier & Solem, 1952).

The leader also plays a constructive role insofar as he can facilitate communications and thereby reduce misunderstandings (Maier, 1952; Solem, 1965). The leader has an adverse effect on the end-product when he suppresses minority views by holding a contrary position and when he uses his office to promote his own views (Maier & Hoffman, 1960b, 1962; Maier & Solem, 1952). In many problem-solving discussions the untrained leader plays a dominant role in influencing the outcome, and when he is more resistant to changing his views than are the other participants, the quality of the outcome tends to be lowered. This negative leader-influence was demonstrated by experiments in which untrained leaders were asked to obtain a second solution to a problem after they had obtained their first one (Maier & Hoffman, 1960a). It was found that the second solution tended to be superior to the first. Since the dominant individual had influenced the first solution, he had won his point and therefore ceased to dominate the subsequent discussion which led to the second solution. Acceptance of a solution also increases as the leader sees disagreement as idea-producing rather than as a source of difficulty or trouble (Maier & Hoffman, 1965). Leaders who see some of their participants as trouble-makers obtain fewer innovative solu-

tions and gain less acceptance of decisions made than leaders who see disagreeing members as persons with ideas.

#### THE LEADER'S ROLE FOR INTEGRATED GROUPS

##### *Two Differing Types of Group Process*

In observing group problem solving under various conditions it is rather easy to distinguish between cooperative problem-solving activity and persuasion or selling approaches. Problem-solving activity includes searching, trying out ideas on one another, listening to understand rather than to refute, making relatively short speeches, and reacting to differences in opinion as stimulating. The general pattern is one of rather complete participation, involvement, and interest. Persuasion activity includes the selling of opinions already formed, defending a position held, either not listening at all or listening in order to be able to refute, talking dominated by a few members, unfavorable reactions to disagreement, and a lack of involvement of some members. During problem solving the behavior observed seems to be that of members interacting as segments of a group. The interaction pattern is not between certain individual members, but with the group as a whole. Sometimes it is difficult to determine who should be credited with an idea. "It just developed," is a response often used to describe the solution reached. In contrast, discussions involving selling or persuasive behavior seem to consist of a series of interpersonal interactions with each individual retaining his identity. Such groups do not function as integrated units but as separate individuals, each with an agenda. In one situation the solution is unknown and is sought; in the other, several solu-

tions exist and conflict occurs because commitments have been made.

### *The Starfish Analogy*

The analysis of these two group processes suggests an analogy with the behavior of the rays of a starfish under two conditions; one with the nerve ring intact, the other with the nerve ring sectioned (Hamilton, 1922; Moore, 1924; Moore & Doudoroff, 1939; Schneirla & Maier, 1940). In the intact condition, locomotion and righting behavior reveal that the behavior of each ray is not merely a function of local stimulation. Locomotion and righting behavior reveal a degree of coordination and interdependence that is centrally controlled. However, when the nerve ring is sectioned, the behavior of one ray still can influence others, but internal coordination is lacking. For example, if one ray is stimulated, it may step forward, thereby exerting pressure on the sides of the other four rays. In response to these external pressures (tactile stimulation), these rays show stepping responses on the stimulated side so that locomotion successfully occurs without the aid of neural coordination. Thus integrated behavior can occur on the basis of external control. If, however, stimulation is applied to opposite rays, the specimen may be "locked" for a time, and in some species the conflicting locomotions may divide the animal, thus destroying it (Crozier, 1920; Moore & Doudoroff, 1939).

Each of the rays of the starfish can show stepping responses even when sectioned and removed from the animal. Thus each may be regarded as an individual. In a starfish with a sectioned nerve ring the five rays become members of a group. They can successfully work together for loco-

motion purposes by being controlled by the dominant ray. Thus if uniformity of action is desired, the group of five rays can sometimes be more effective than the individual ray in moving the group toward a source of stimulation. However, if "locking" or the division of the organism occurs, the group action becomes less effective than individual action. External control, through the influence of a dominant ray, therefore can lead to adaptive behavior for the starfish as a whole, but it can also result in a conflict that destroys the organism. Something more than external influence is needed.

In the animal with an intact nerve ring, the function of the rays is coordinated by the nerve ring. With this type of internal organization the group is always superior to that of the individual actions. When the rays function as a part of an organized unit, rather than as a group that is physically together, they become a higher type of organization—a single intact organism. This is accomplished by the nerve ring, which in itself does not do the behaving. Rather, it receives and processes the data which the rays relay to it. Through this central organization, the responses of the rays become part of a larger pattern so that together they constitute a single coordinated total response rather than a group of individual responses.

### *The Leader as the Group's Central Nervous System*

If we now examine what goes on in a discussion group we find that members can problem-solve as individuals, they can influence others by external pushes and pulls, or they can function as a group with varying degrees of unity. In order for the latter function to be maximized, however, something must be introduced to serve the func-

tion of the nerve ring. In our conceptualization of group problem solving and group decision (Maier, 1963), we see this as the function of the leader. Thus the leader does not serve as a dominant ray and produce the solution. Rather, his function is to receive information, facilitate communications between the individuals, relay messages, and integrate the incoming responses so that a single unified response occurs.

Solutions that are the product of good group discussions often come as surprises to discussion leaders. One of these is unexpected generosity. If there is a weak member, this member is given less to do, in much the same way as an organism adapts to an injured limb and alters the function of other limbs to keep locomotion on course. Experimental evidence supports the point that group decisions award special consideration to needy members of groups (Hoffman & Maier, 1959). Group decisions in industrial groups often give smaller assignments to the less gifted (Maier, 1952). A leader could not effectually impose such differential treatment on group members without being charged with discriminatory practices.

Another unique aspect of group discussion is the way fairness is resolved. In a simulated problem situation involving the problem of how to introduce a new truck into a group of drivers, the typical group solution involves a trading of trucks so that several or all members stand to profit. If the leader makes the decision the number of persons who profit is often confined to one (Maier & Hoffman, 1962; Maier & Zeffoss, 1952). In industrial practice, supervisors assign a new truck to an individual member of a crew after careful evaluation of needs. This practice results in dissatisfaction, with the charge of *unfair*

being leveled at him. Despite these repeated attempts to do justice, supervisors in the telephone industry never hit upon the notion of a general reallocation of trucks, a solution that crews invariably reach when the decision is theirs to make.

In experiments involving the introduction of change, the use of group discussion tends to lead to decisions that resolve differences (Maier, 1952, 1953; Maier & Hoffman, 1961, 1964a, 1964b). Such decisions tend to be different from decisions reached by individuals because of the very fact that disagreement is common in group problem solving and rare in individual problem solving. The process of resolving difference in a constructive setting causes the exploration of additional areas and leads to solutions that are integrative rather than compromises.

Finally, group solutions tend to be tailored to fit the interests and personalities of the participants; thus group solutions to problems involving fairness, fears, face-saving, etc., tend to vary from one group to another. An outsider cannot process these variables because they are not subject to logical treatment.

If we think of the leader as serving a function in the group different from that of its membership, we might be able to create a group that can function as an intact organism. For a leader, such functions as rejecting or promoting ideas according to his personal needs are out of bounds. He must be receptive to information contributed, accept contributions without evaluating them (posting contributions on a chalk board to keep them alive), summarize information to facilitate integration, stimulate exploratory behavior, create awareness of problems of one member by others, and detect when the group is ready to resolve differences and agree to a unified solution.



Since higher organisms have more than a nerve ring and can store information, a leader might appropriately supply information, but according to our model of a leader's role, he must clearly distinguish between supplying information and promoting a solution. If his knowledge indicates the desirability of a particular solution, sharing this knowledge might lead the group to find this solution, but the solution should be the group's discovery. A leader's contributions do not receive the same treatment as those of a member of the group. Whether he likes it or not, his position is different. According to our conception of the leader's contribution to discussion, his role not only differs in influence, but gives him an entirely different function. He is to serve much as the nerve ring in the starfish and to further refine this function so as to make it a higher type of nerve ring.

This model of a leader's role in group process has served as a guide for many of our studies in group problem solving. It is not our claim that this will lead to the best possible group function under all conditions. In sharing it we hope to indicate the nature of our guidelines in exploring group leadership as a function quite different and apart from group membership. Thus the model serves as a stimulant for research problems and as a guide for our analyses of leadership skills and principles.

#### CONCLUSIONS

On the basis of our analysis, it follows that the comparison of the merits of group versus individual problem solving depends on the nature of the problem, the goal to be achieved (high quality solution, highly accepted solution, effective communication and understanding of the solution, innovation,

a quickly reached solution, or satisfaction), and the skill of the discussion leader. If liabilities inherent in groups are avoided, assets capitalized upon, and conditions that can serve either favorable or unfavorable outcomes are effectively used, it follows that groups have a potential which in many instances can exceed that of a superior individual functioning alone, even with respect to creativity.

This goal was nicely stated by Thibaut and Kelley (1961) when they

wonder whether it may not be possible for a rather small, intimate group to establish a problem solving process that capitalizes upon the total pool of information and provides for great interstimulation of ideas without any loss of innovative creativity due to social restraints [p. 268].

In order to accomplish this high level of achievement, however, a leader is needed who plays a role quite different from that of the members. His role is analogous to that of the nerve ring in the starfish which permits the rays to execute a unified response. If the leader can contribute the integrative requirement, group problem solving may emerge as a unique type of group function. This type of approach to group processes places the leader in a particular role in which he must cease to contribute, avoid evaluation, and refrain from thinking about solutions or group *products*. Instead he must concentrate on the group *process*, listen in order to understand rather than to appraise or refute, assume responsibility for accurate communication between members, be sensitive to unexpressed feelings, protect minority points of view, keep the discussion moving, and develop skills in summarizing.

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(Received October 24, 1966)