CONCEPTUAL LEVEL AS A COMPOSITION VARIABLE IN SMALL GROUP DECISION-MAKING

PAUL STAGER

PRINCETON UNIVERSITY

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PAUL STAGER
DEPARTMENT OF PSYCHOLOGY
PRINCETON UNIVERSITY

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D. Paul Stager

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Conceptual Level as a Composition Variable in Small Group Decision-Making

Paul Stager

Abstract

Decision-making in small groups, varying in composition along a dimension of conceptual level, was investigated from the standpoint of the emergent functional role structure, conflict generation, utilization of conflict in decision synthesis, and information acquisition. The study was directed toward an understanding of the relationship between the conceptual level dimension (the independent variable) and the dependent variables of group information processing structure and specific predecisional processes.

Individuals located at different positions on the conceptual level dimension exhibit different specific information processing behaviors. Since these specific behaviors are closely related to the traditional phases of decision-making (problem perception, information search, generation of alternatives, hypothesizing of consequences, and selection of alternatives), the specific predecisional processes were described as constituting these behaviors. If the phases are considered as functional roles, then the process of decision-making can be viewed as an integration of specific roles. The variable, group information processing structure, was defined as the degree of interlocking of functional roles in the group decision-making mechanism. The metric applied to group structure was the information measure H, which was based on the frequencies with which the different functional roles were assumed by the individual group members. A low value of H for a group would be obtained when the members tend

to organize into a rigid structure of separate roles. Conversely, a high value of H for a group would be found when the members tend to exhibit "flexibility" by assuming different roles at different times.

On the basis of the conceptual systems theory, the following hypotheses were advanced:

(a) structuring decreases or, conversely, role flexibility increases, as the percentage of members of a high conceptual level (PMHCL) in the group increases;

(b) groups, in which the members are all of a high conceptual level (100 PMHCL), manifest more interpersonal conflict than groups in which the members differ in conceptual level;

(c) the extent to which generated conflict is utilized in decision synthesis increases with an increasing PMHCL in the group;

(d) the extent of search for novel information increases as the PMHCL in the group increases, whereas total information search is not dependent upon group composition.

The subjects were male undergraduate and graduate students selected on the basis of structural content analysis scores obtained on the Paragraph Completion Test and scores obtained for the nDominance Scale of the Edwards Personal Preference Schedule. Twenty four-man groups were composed to yield four combinations of conceptual level. The four types of composition comprised groups in which one (25 PMHCL), two (50 PMHCL), three (75 PMHCL), or four (100 PMHCL) of the members, respectively, were of a high conceptual level. Hence, the groups could be located along a dimension of increasing PMHCL. Member dominance was controlled by systematically varying the distribution of high, intermediate, and low nDominance across members of each group. Groups were matched on intelligence. Each group participated in a complex simulated tactical decision-making situation. Acting as four members of equal status on a military field staff, the group received

information concerning enemy movements and the effect of their own decisions by means of a programmed informational input.

Each of the hypotheses advanced was confirmed by the obtained results. Group structuring, utilization of generated conflict, and search for novel information were linearly related, while interpersonal conflict was curvilinearly related, to an increasing PMHCL in the group. The observations indicated that the concept of a continuous dimension of increasing PMHCL, as a prediction variable for specific group decision processes, was tenable. The underlying concept of uncertainty reduction was concluded to be applicable to group structuring, conflict generation, information evaluation, and information search.

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INTRODUCTION

Overview of the problem

Small groups active in the decision-making process are concerned with the three distinct but interrelated functions of information acquisition, information processing, and subsequent decision-making. The effectiveness of the decision-making process in the groups would seem to depend upon the quality of the differentiated component processes and the degree to which the three functions are integrated within the groups.

There is considerable evidence in the small group literature (Bass, 1960; Collins & Guetzkow, 1963; Steiner, 1964) that heterogeneity of group composition may, in some instances, facilitate and, in others, be detrimental to the integration of group processes. The level of performance on certain tasks is frequently a function of the extent to which group processes are integrated. The effect of group composition on performance is dependent upon the type of situation or task confronting the groups and upon the composition variables. There is a definite interaction effect between individual and situational variables. Both sets of variables act as intervening variables in mediating human performance and have been viewed as variable "complexes" (Ware, 1964).

One critical personality and composition variable which has been shown to be a determinant of performance in decision-making tasks is the conceptual level dimension; this dimension describes the integrative complexity of a group member's conceptual structure (Schroder, Driver, & Streufert, in press). Conceptual structure refers to a set of cognitive mediating links which produces a relatively stable group of techniques by which the individual receives, processes, and transmits information. The integrative complexity of conceptual structure is a function of the number of dimensions along which stimuli are ordered, the number of different schemata with which the perceived dimensions

of information are organized, and the complexity of the organization. Individuals whose information processing is characterized by the use of few dimensions of information and few or fixed integrating schemata in a given domain are described as having a low conceptual level (LoCL); individuals who typically perceive many dimensions of information and utilize many alternate combinatory schemata and linkages between these schemata are described as having a high conceptual level (HiCL). Although the level of information processing tends to increase with an increase in the level of conceptual structure, the former can vary as a function of various forms of environmental stress. Groups, comprising members who differ in conceptual level (heterogeneous groups), exhibit performance characteristics which are distinct from groups comprising members with similar levels of conceptual structure (homogeneous groups) (Tuckman, 1966).

Previous studies concerning group composition (Kennedy & Dold, 1965; Stager & Kennedy, 1965; Tuckman, 1966) focused primarily upon group performance rather than group processes. The next logical step seemed to be to direct attention toward the differences in group functioning, attempting to relate the conceptual level dimension to emergent group information processing structures and the characteristic decision-making processes. Since previous studies had not included the type of composition in which there are an equal number of HiCL and LoCL members, the present study was directed toward an analysis of a distribution of different group compositions representing a continuous -- rather than discontinuous (viz. Tuckman, 1966) -- composition dimension. The dimension described an increasing percentage of members of a high conceptual level (PMHCL) in the group.

In view of the direction which research involving group composition had taken, the immediate question seemed to be not so much whether there was a performance differential between HiCL homogeneous groups and heterogeneous groups

on specific decision tasks, but rather what kinds of group information processing structures emerge in groups comprising various combinations of member conceptual structures.

Context of the problem

Group decision-making

Most of the analyses of the group decision-making process appear to derive by analogy from the stages or phases believed to exist in the individual decision process. Schroder and Harvey (1963), although not dealing with decision-making per se, have attempted to extend their theorizing about structural determinants of the individual system functioning (Harvey & Schroder, 1963) to that of social systems. In generalizing across levels of analysis, from individual to group systems, they have suggested that it is not improbable that certain structural aspects of systems dispose toward a particular kind of operation or level of information processing, irrespective of the specific content of the system. Hence, as long as organizational or structural features of systems and not content are treated, then possibly, they conclude, the parallels may be more real than just analogous. Conversely, Bales has suggested (1950) that the best model for understanding individual decision-making may be the interaction which occurs in group problem solving. The rationale underlying Bale's approach, however, appears similar to one of the fundamental aspects of the conceptual systems theory; conceptual level (alternatively, the way an individual thinks) is a reflection of the type of social environment in which the individual learned to adapt (Schroder, Driver, & Streufert, in press). The rationale advanced by Bales is that individual decision-making "... is essentially in form and genesis a social process; thinking is a re-enactment by the individual of the problem-solving process as he went through it with other individuals" (Bales, 1950, p. 62). Kelly and Thibaut (1954) have proposed, for example, that the individual may acquire his thought and judgemental habits largely through interaction

with other persons, "internalizing" certain decision-making functions which were originally performed for him by others. The individual may internalize or adopt a "critic" role in the sense of learning to apply to himself the same standards and rules of critical evaluation that others have manifested in interaction with him.

Group decision-making, in any case, is of necessity mediated by individual processes. In the group situation, decision-making requires interpersonal communication; hence, many of the sequences that would otherwise occur in the individual become visible to the observer. As March and Simon (1958) have stated, however, generalizing from individual to group decision-making is valid only if the processes are more or less similar. In the opinion of March and Simon, group decision-making studies contrast the coordinative techniques available to a group of persons with those of the individual organism. Such studies show generally that "... interpersonal communication is a more primitive and limited coordinative mechanism than are the neural processes. Consequently, factorization of problems into semi-independent subparts is of more crucial importance for groups than for individual problem-solving" (March & Simon, 1958, p. 192).

Although it may be concluded that group decision-making involves considerably more than simply the processes which characterize individual decision-making, the conclusion does not necessitate the postulating of some sort of "group mind" concept (Golembiewski, 1962; Kelly & Thibaut, 1954; Minas & Ackoff, 1964). The conclusion derives from the fact that the information processing done by a group occurs in a specifically social situation. Member information processing and subsequent decision-making is subject to an agreement or consensus process which is itself a function of the characteristic structural organization of the group. The interacting group has a wide range of information, in view of its storage capacity (Perlmutter, 1953), and a significant critical facility, but, as

previously suggested, the effectiveness of the group depends upon the characteristics of the task environment. Moreover, an individual participant in the group is profoundly influenced by the other individuals who comprise his "interpersonal environment" (Collins & Guetzkow, 1964). The experience of interacting with other participants strongly affects the behavior of each individual. The functioning of a group is frequently determined by the ability of each individual member to relate himself to other group members as well as by his information processing capability; hence, there would seem to be an inherent difficulty in generalizing from group processes to individual processes in decision-making. For example, if either the decision task environment or the interpersonal environment demands that certain patterns of communication among group members be established, an individual member can no longer attend only to the task environment; the group member must then concern himself with the communication behavior of the other members (Collins & Guetzkow, 1964); communication patterns appear to be influential in changing the behavioral characteristics of group members (Berkowitz, 1956) and would, therefore, complicate any generalization across systems.

In view of the complexity of group decision-making, a knowledge of individual decision-making characteristics, on the other hand, could contribute to the interpretation of group functioning if only by providing a basis for comparison. If the information processing characteristics of levels of individual conceptual structure were known, then a more meaningful assessment of the decision-making processes in different emergent group information processing structures could be obtained. Given that some of the processes which theoretically characterize different levels of conceptual structure have been empirically validated (Lanzetta & Sieber, 1964; Schroder, Driver, & Streufert, in press), then analysis of the individual contributions, in relation to the overall group

functioning, should provide a means of determining the relationship between the conceptual level dimension and the emergent group information processing structure. In order to relate the conceptual level of the group members to the group processes and group structure, analyses at both the individual and the group level are required.

Decision-making environments

Many of the current theories of decision-making and information search (or uncertainty reduction) are based on observations made in specific and relatively simple situations which are often probabilistic in nature (Coombs & Beardslee, 1954; Edwards, 1956) and involve such concepts as economic utility (Edwards, 1954, 1956, 1961, 1962; Lanzetta & Karaneff, 1962; Marschak, 1954, 1964; Scodel, Ratoosh, & Minas, 1959). According to such theories, information has value to the extent that it increases the probability of choosing the alternative which yields the greatest probability of payoff. Theories of probabilistic information processing and economic utility assume that the decision-making is theoretically rational in nature. March and Simon (1958) do not find the model of rational man tenable since only in the case of certainty or well defined situations does it agree with the common sense notions of rationality. Secondly, the existing models place exceedingly important demands upon the decision-making mechanism. Such models assume that all of the alternatives are given, that all the consequences attached to each alternative are known, and that the decision maker has a complete utility ordering for all possible sets of consequences. Moreover, as Simon has suggested (1963), once the distinction between the objective and subjective environment is made, prediction of decision-making behavior -- even if the behavior is "rational" -- from the characteristics of the objective environment becomes difficult. Prediction can be enhanced only if something is known about the perceptual and cognitive processes involved. Rapoport has noted (1964) that there is an "... inherent tendency in strategic thinking to simplify the analyses of the situation in order to make a decision problem more tractable"

(1964, p. 212). As the complexity of the problem increases, the strategist is increasingly aware of the necessity to simplify the situation, either by casting it into a simple model or by circumventing the problem of estimating the data or information required to solve the associated decision-problem. Sweetland and Haythorn (1961), also, have concluded that decision-making in a complex situation must involve the decision maker's constructing a model of the situation and then functioning within that model. Similarly, March and Simon (1958) have attempted to take into account the effects of the perceptual and problem-solving processes which are known to be active. In their theorizing, decision-making is exercised with respect to a limited, approximate, simplified "model" of the real situation. The elements of the decision-maker's "definition of the situation" are not given, but are themselves the result of the characteristic information processing.

Model building in complex decision situations appears to be one of the important characteristics of the decision-making process and may be one of the sources of interaction effects. More importantly, however, the phenomenon emphasizes the necessity of developing a system of mediating concepts and a means of analyzing the environmental demands. As Krupp has indicated (1961), the importance of the environment in decision-making theories has in one sense been obscured since it has been persistently viewed as a "closed system". The concept of a "closed system" (see for example, Bartlett, 1959; March & Simon, 1958) fails to incorporate the extent of complexity and the degree of uncertainty which characterizes the higher level decision situations, such as those found in organizational, governmental, and military environments. Meaningful descriptions of these environments are extremely difficult to derive although current attempts at classification appear promising. A comprehensive system of classification, based on the "critical demands" which the environment places upon the decision-makers, has been proposed by Roby and Lanzetta (1958). Their scheme recognizes the relevance of the organism, the interaction effects, in classifying

environments, but lacks a systematic set of concepts which mediate input and output variables. The description proposed by Schroder, Driver, and Streufert (in press) does, however, involve mediating concepts which relate environmental properties such as information load, information diversity, and rate of information change, to the output variables in the system. Since information search has been considered one of the fundamental aspects of decision-making, it is important to note that Schroder, Driver, and Streufert have described one of the environmental properties which influences decision-making; namely, the orientation or organizational effects, induced by the task, which affect the way in which the decision maker perceives or reacts to the situation by reducing or enhancing the complexity of the informational environment. Situational characteristics which reduce or facilitate the degree to which an organism explores the environment indirectly affect the complexity of the environment.

Although the environmental dimensions emphasized in one classification scheme may differ from those emphasized in another, the dynamic-decision situation has certain "higher order" characteristics which are tenable across different dimensional systems. In dynamic decision theory, decisions are made sequentially; the environment in which the decision is set may be changing either as a function of the sequence of decisions, independently of them, or both. Such an environment has been termed non-stationary (Edwards, 1962), the environment and information being affected by the sequential decisions; information obtained as a result of earlier decisions is relevant to later decisions. Non-stationary environments, in which decisions and actions at one point change the environment in such a way that subsequent decisions require new additional information or reprocessing of the previously acquired information, have also been described as information-interdependent (Harvey, Hunt, & Schroder, 1961; Schroder & Harvey,

1963; Schroder, Driver, & Streufert, in press). Several situations, based on the concept of an information-interdependent environment, have been designed (see for example Schroder, Driver, & Streufert, in press; Kennedy & Schroder, 1964; Stager & Kennedy, 1965; Tuckman, 1964, 1966), but there has not yet been a satisfactory scheme derived for evaluating the decisions (although see Rath & Allman, 1964). A persistent problem in describing environments is the nature of environmental complexity, although dynamic decision-making situations are characteristically described as being "complex"; the introduction of risky choices into such decisions is thought to enhance the complexity of the situation as well as to complicate descriptive theory (Rapoport, 1964). Another factor of dynamic decision-making which is thought to contribute to complexity is the possibility that a single decision-maker may be involved in more than one decision situation simultaneously; the current values of decision variables from other decision situations may be informationally relevant to his function in a given situation (Rigby, 1964). Rigby has suggested, " ... the complexity of decision structure has been swept under the rug by ascribing it to structures of decision situations and limiting attention to one decision situation at a time" (1964, p. 39).

A substantial basis for describing an environment as complex would seem to require a quantitative assessment of those elements which complexity theoretically comprises. Few situations, seem to be amenable to the application of information theory (Garner, 1962), although current research (Koslin, 1965) does indicate that carefully designed situations are tractable by such an approach. While there is a persistent difficulty in assessing the complexity of the objective environment, the organisms in a dynamic situation create their own characteristic level of environmental complexity, frequently by constructing a simplified model of the decision environment. There is the assumption, however, that even while working in accord with a model, the organism confronts significant demands in the decision processes.

The decision processes

There exists in decision-making certain requirements which, with respect to the various criteria which may be used to assess the final decision, must be met in a more or less fixed chronological sequence. These requirements have sometimes been described as programs (March & Simon, 1958) or phases (Bales & Strodtbeck, 1951) and, hence, constituting the processes of decision-making, are consistent across individual and group decision-making. The formal description of a decision situation includes a statement of the possible courses of action available, a listing of the possible consequent states, and a matrix representing the outcome if a particular course of action is followed. Given a specific situation, probabilities may or may not be associated with the possible outcomes. The overall requirement of the decision maker is to specify the course of action which will maximize the outcome that he realizes (Hunt & Zink, 1964).

The formal description of the decision process, however, greatly oversimplifies the problem: making a choice is merely the final phase in a chain of psychological-decision processes. In dynamic situations, the decision maker must go beyond given data, hypothesizing the consequences, before the selection of alternatives (Gyr, 1960).

March and Simon (1958) have proposed that in the dynamic situation both procedural and substantive programs are involved. They are, respectively, the temporal pattern and the structure of the problem solving process.

"The programs, procedural and substantive, that govern problem-solving processes have generally a hierarchical structure. From a procedural standpoint this means that the problem goes through a sequence of broad phases (e.g., 'problem formulation', 'search for alternatives', 'evaluation of alternatives', etc.), but that each of these phases may be made up, in turn, of similar phases at a more microscopic level of detail. On the substantive side, a similar

sequence of levels may be apparent: the problem is first analyzed in broad terms; each of its aspects becomes, in turn, a subproblem to be further analyzed in detail" (1958, p. 179).

The decision maker necessarily, then, first acquires and organizes information about a decision situation; he evaluates the information available and determines if other information is necessary. Only after acquiring as much information as seems reasonable, does he make a selection, which he hopes is "optimal" in some sense. (Hunt & Zink, 1964). There is some question about the concept of optimality, however (Shelly & Bryan, 1964). March and Simon have proposed (1958) that "... most human decision-making, whether individual or organizational, is concerned with the discovery and selection of satisficing alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives. To optimize requires processes several orders of magnitude more complex than those required to satisfice" (1958, pp. 140-141). Satisficing is the selection of satisfactory rather than optimal or maximizing alternatives in decision-making. Optimizing or maximizing requires a thorough analysis of the environmental information, but it is doubtful that decision-making is truly optimal in view of the constraints operating in the complex decision environment; the process is probably at best characterized as one of "constrained optimality" (Shuford, 1964b).

In any case, the processes of searching for and acquiring information, and of organizing and evaluating information, have been termed "predecisional processes" (Hunt & Zink, 1964). The predecisional processes are an essential part of the complete decision sequence. March and Simon have proposed that problem-solving activities can, in fact, "...generally be identified by the extent to which they involve search: search aimed at discovering alternatives of action or consequences of action" (1958, p. 140). Although typical research on decision-making has frequently passed over the predecisional processes, they are beginning to

receive increasingly more attention (see for example, Hunt & Zink, 1964), particularly from cognitive theorists (viz. Schroder, Driver, & Streufert, in press). More extensive study of the predecisional processes should, as Shuford has suggested (1964a), lead to a better understanding of how an organism interprets and structures a decision task. Toda has recently (1964) distinguished pre- and post-decisional processes. Postdecisional processes begin at the moment of decision-making and end with the completion of a local program or perception of a problem. The predecisional processes begin with problem perception and end with decision-making. A predecisional process in a higher level context, however, consists of an alternating sequence of pre- and post-decisional processes in a lower context. Such is the case in the decision of whether additional information should or should not be acquired. Toda hesitates to use only " ... this informational aspect, that is the raised and lowered threshold to problem-perception, for the definition of decision-making and decision suspension respectively. Still ... they are the best parameters for the identification of pre- and postdecisional processes" (p. 90).

Although Toda has hesitated to use the informational aspect in his definition of the predecisional process, it is specifically that aspect which characterizes current interest in the predecision part of decision-making. That is to say, the requirements of the decision situation, such as the specification of the problem, the generation of alternatives, and the evaluation of alternatives in view of hypothesized consequences, are now recognized as significant concomitants of (or more specifically, inducements for) information search and complex information processing. The complete significance of information search and processing may not have been sensed in view of the fact that research on decision-making has frequently been concerned with decision processes as they occur in structured or well defined systems or environments. In other

words, when there has been an interest in the "predecisional processes", in the context of static decision environments they have been viewed or summarized as maximizing or optimizing strategies derived by researchers in a post hoc manner. With the introduction of "ill-defined" (Reitman, 1964) or unstructured decision situations, the phenomenon of information search and processing of incomplete information became significant determinants of decision quality.

If interest is restricted to ill-defined problems or, alternatively, "open systems", the proposition that alternatives are not given but must be sought is not merely an assertion about the human situation but instead becomes a theorem which may be derived indirectly from the basic definition of an ill-defined situation. The concept of an ill-defined problem "... rests on the concept of an open attribute, that is an attribute 'whose definition includes one or more parameters, the value of which are left unspecified as the problem is given to the problem solving system from outside or transmitted within the system over time'" (Reitman, 1964, p. 314). In order to solve an ill-defined problem, whatever is required to close the open constraints must be sought or generated by the organism. In some instances, a routine memory search may be sufficient; in other situations, however, a complex sequence of processing may be required. In dynamic situations, for example, the various aspects of complex action unfold at different rates so that the consequent constraining effects vary progressively.

Moreover, the actions available at a given time depend upon the decisions made up to that time. In such situations, it is necessary to decide what new alternatives have been introduced and what others have been eliminated. Obtaining additional information about any or all of the categories of interest is only one kind of action (Kochen & Galanter, 1958), and the alternatives effectively available depend upon the state of the knowledge of the decision maker.

The search for information, therefore, as an essential part of decision-making, has to be programmed into the decision process; one higher level procedural program, in the terminology of March and Simon (1958), is the search to determine the likely sources of information. Particularly in group decision-making, an important technique for obtaining information is to direct a request to some member who has the information rather than to search for it in a more time consuming manner; in order to do the former, however, a search may be needed to determine which member has the requisite information. March and Simon suggest, therefore, that "...one important element of organizational structure is a set of understandings and expectations among the participants as to what bodies of information repose where in the structure. The set of expectations and understandings is a major determinant of communication channels" (1958, p. 180).

In summary, it appears that the predecisional processes comprise the processes of problem perception, the search for relevant information, the accumulation and storage of information, the generation of alternatives, and the evaluation of acquired information and emergent alternatives. Moreover, in suggesting that there are certain understandings and expectations concerning information processing and storage, March and Simon are, indirectly, implying that at least one of the predecisional processes can be represented in the group situation by something like a functional role.

Functional roles and group processes

Role has been viewed as "...the behavior of a person that is regarded by relevant others as appropriate to the position he occupies" (Thomas, 1960). In other words, "...the actual behavior of a person occupying a position in a group remains as something to be understood in terms of the expectations which are imposed from without and the tendencies of his personality which express themselves from within (Hare, 1962, p. 102). As groups increase in size and

complexity, individuals tend to specialize in some aspect of the interaction process. The expectations for behavior in these specialties are represented by the roles of the group members. Expectation, then, characterizes the concept of role; Sargent (1951) has stressed the extent to which assuming roles depends upon perception and interpretation of these expectations, viewing a person's role as the pattern or type of social behavior which seems situationally appropriate to him in terms of the demands and expectations of those in his group. A second characteristic of role, however, seems to be the overt expression of the individual's tendencies toward certain categories of behavior. The playing of a role depends not only on the expectations of the other group members but also the capability of the member to perceive and respond to the expectations.

In reviewing the literature, Miller (1963) concluded that despite the widespread interest in roles, few attempts have been made to classify them. Few of the proposed categories have been used in systematic research and there is some difficulty in determining their efficacy. One category of roles which may contribute to group analyses is that of functional roles. Functional roles are so termed because they have a functional relation to the group performance; they seem to have different behavioral correlates; they are performed under the expectation of other group members. To Golembiewski (1962), the implications, for example, of the "functional role" concept for research seems clear: "...until functional roles...are used to classify the batches of laboratory collectivities often considered aggregatively in small group analysis, the interpretation of the results must remain problematical" (p. 284).

Benne and Sheats (1948) categorized group behavior on the basis of functional roles which, among others, they described as the "energizer" (who directs the group toward action), the "information seeker", the "initiator-contributor" (who proposes new ideas), the "elaborator" (who clarifies the ideas), the "opinion

giver" (who states his opinion in regard to a given suggestion), and the "evaluator-critic". In working with functional roles and concentrating on the efficacy of the groups, Benne and Sheats developed the concept of "role flexibility", which was similar to Gibb's (1960) "role repertoire". Categorization similar to Benne and Sheats was used by Deutch (1949) who studied the three broad groupings of task functions, group functions, and individual functions. Of present interest are his task functions which included participation with the immediate purpose of facilitating problem solution. The task grouping included functions such as initiator-contributor, information-giver, position-stater, elaborator, coordinator, orientor, evaluator-critic, energizer, and information seeker. Bass (1954) also used the Benne and Sheats method successfully in evaluating emergent group leadership in leaderless discussion groups.

A related but distinctly different approach was developed by Bales (Bales & Strodtbeck, 1951) as a means of analyzing group interaction in problem solving situations. Bales found that groups tended to follow a consistent pattern of phases, which were qualitatively different subperiods within a total continuous period of interaction. Using a system of twelve categories of behavior, Bales considered the phases to be those periods which were characterized by significant differences in the frequency of specific contributions.

Heyns (Heyns & Zander, 1953; Heyns & Lippitt, 1954) has presented the problem solving categories which were used in the University of Michigan Conference Research Project. The category system included the categories of goal-setting, problem-proposing, information-seeking, information-giving, solution-proposing, development-seeking, development-giving, opposing, supporting, summary-seeking, summary-giving, and non-problem-directing. The system attempted to be fairly exhaustive while focusing only on the group decision-making process.

In a paradigm for analyzing group interaction, Hare (1960) suggested that the categories of observing, hypothesizing, and proposing action might, at the level of personality, represent the tendencies to act, and, at the level of role, represent expectations for behavior. Like the previous systems, however, this paradigm does not directly question the basis for "the tendencies to act" or role differentiation. Guetzkow (1960) suggested that the factors associated with role differentiation may be viewed as comprising two types -- those external environmental factors which induce role formation because of task components, and those internal processes involved in the establishment of particular persons in roles. Here there is a definite implication of interaction effects, but more importantly there is an implied need for further specification of structural determinants.

Recently there have been numerous attempts (Carter, 1954; Crowell & Scheidel, 1961; Hoffman & Maier, 1961; McGrath, 1963; McWhinney, 1963; Oeser & Harary, 1962, 1964; Rinn, 1963; Roby, 1957; Rudner & Wolfson, 1962; Stone, 1963; Wolfe, 1961) to develop satisfactory dimensions or systems for analyzing small group interaction, but the basis of the difficulty, in deriving dimensions for the decision process analyses, is essentially the same as that which accounts for the difficulty in dimensionalizing the decision environments. Dimensionalization of both areas of research requires a system of mediating concepts, concepts which mediate between input and output in the environment, on the one hand, and between given group members and observed role-contributions in the group information processing structure, on the other. In the discussion of the decision environment, reference was made to the system of mediating concepts proposed by Schroder, Driver, and Streufert (in press). Given the context of the decision situation, the concepts described by these authors, in their information processing approach to personality, seemed to provide a means for relating conceptual structure to the

functional roles which have been observed in group decision-making. Moreover, the information processing concepts of uncertainty and structure (Garner, 1962) seemed to provide a basis upon which a system for assessing the emergent group information processing structure could be developed.

Consideration of the information processing characteristics of the different levels of conceptual structure (viz. Schroder, Driver, and Streufert, in press) suggested that the programs or requirements of the predecisional processes would be differentially accommodated by the LoCL and HiCL members in the groups. In other words, there seemed to be justification for assuming that if role differentiation occurred, the differentiation would follow the requirements of the decision process and that the roles assumed by the members would be a function of their conceptual level. By the same reasoning, it was tentatively suggested that heterogeneity of the group composition would facilitate the emergence of role differentiation, the LoCL members assuming fewer specific functional roles regardless of the particular heterogeneous composition in which they were included.

Granting that individuals, located at different positions on the conceptual level dimension, exhibit different specific information processing behaviors and that these specific behaviors are closely related to the traditional requirements or phases of decision-making (problem perception, information search, generation of alternatives, hypothesizing consequences, and selection of alternatives), then the decision-making process can be described as constituting these behaviors. If the phases are then considered as functional roles, which are assumed differentially by LoCL and HiCL members, the process of decision-making can be viewed as an integration of specific roles. The term group information processing structure, therefore, can be understood as an analytical term which is defined as the degree of interlocking of functional roles in the group decision-making mechanism.

In a complex dynamic-decision situation, which involves only the acquisition and processing of information prior to the decision per se, there is scant opportunity for the group to structure itself except along the lines provided by the decision process. The structuring problem becomes one, essentially, of distributing responsibility for the various programs or requirements of the decision process; the degree of structuring becomes a question of the extent to which the responsibilities for the various programs are member specific.

The information processing concepts of uncertainty and structure suggest an approach for assessing this type of group structuring even though the concepts are used in a verbal and, thus, somewhat less exact form. In relation to structuring, Garner (1962) has suggested that any group of persons can relate to itself or to individuals and groups outside itself. There is the condition, however, that "...the total structure is limited by the uncertainty within the group, and the greater the amount of internal structuring, the less must be the external structuring" (p. 344). In other words, it would appear, in the context of decision-making, that the more a group is internally structured, the less freedom exists for its members to relate to external or environmental variables. If all of the members, over a series of decisions, do not have a tendency to assume all of the possible functional roles -- if there is not an interchanging of roles during sequential decision-making -- then this introduction of redundancy increases internal constraint or internal structuring. The role structuring within a group is tractable by the information measure of uncertainty H. If it is assumed that the different functional roles represent different categories of events, then by noting the frequency with which the different functional roles are assumed, a frequency or probability distribution for the categories can be generated. The uncertainty involved in the distribution is obtained by applying the Shannon measure of average information (viz. Garner, 1962). Maximum uncertainty for any distribution with a given number of categories occurs when all

categories have equal probabilities. In reference to the degree of structuring within a group, the uncertainty or H value for each member's participation can be determined and then combined with the H values of the other members, thus providing a total H value for the group. A low value of H for a group would be obtained when the members tend to organize into a rigid structure of separable roles. Conversely, a high value of H for a group would be found when the members tend to exhibit "flexibility" by assuming different roles at different times in sequential decision-making. Groups, therefore, could reduce the amount of uncertainty in their information processing structure or, more generally, in their environment, by organizing into a decision-making structure in which the different members assumed different specific functional roles. Since the ability to cope with uncertainty in a system is a function of the level of conceptual structure, the information concepts of uncertainty and structure provide a method, which is meaningful within the conceptual systems framework, for relating the conceptual level dimension to the emergent structure of decision-making mechanisms.

Emergent structuring may also occur, however, with respect to status (Heinicke & Bales, 1953) or communication (March & Simon, 1958), although communication structure might be considered as a superordinate type of structuring which reflects a different kind of structuring at a lower level. Knowledge concerning the manner in which groups are structured with respect to information processing would contribute to a more meaningful interpretation of the communication structure. Glanzer and Glaser (1959, 1961) have suggested, for example, that the extensive research in small group communication nets does not appear to have contributed to the development of a theory. Cartwright and Zander (1960, p. 664) proposed that as knowledge of group structure, in reference to communication and task structure, increases, there is the possibility of deriving

means of describing the "more basic (or genotypic)" types of structure; the present conceptualization suggests that an understanding of the genotypic structuring, with respect to the decision processes or even the more basic conceptual structures of the group members, would facilitate interpretation of the phenotypic structuring. What kinds of structuring in group information processing emerge in various group compositions and how the emergent structures are related to the level of conceptual structure of the group members are questions considered in the present study.

Hypotheses

Hypothesis I: With an increase in the PMHCL in the group, there is an increase in the role flexibility or, conversely, a decrease in structuring and more functional role uncertainty (a higher H value).

Theoretically, the HiCL members are able to cope with a higher level of uncertainty in their environment and are more adaptable to environmental demands than LoCL members (Schroder, Driver, & Streufert, in press). Whereas HiCL members may be aware of considerable uncertainty in a situation, without attempting to increase the amount of structuring (reduce uncertainty) (Lanzetta & Sieber, 1964), LoCL members tend to simplify and structure their environment; for example, groups homogeneously composed of LoCL members form hierarchical group structures (Tuckman, 1964). In groups comprising members with different levels of conceptual structure (heterogeneous groups), there is likely to be strong and clearly defined boundaries between subgroups or parts with little integration. If differentiation occurs on the basis of functional roles or task boundaries, heterogeneous groups should be characterized by a high degree of functional role centrality (Hutte, 1965), particularly when there is a low PMHCL in the group. A group composition comprising an equal number of LoCL and HiCL members might create a structuring problem for which resolution would

be difficult to achieve, in view of the differences in the need to reduce uncertainty; the prediction was made that, in task-oriented groups, the urgency of the decision-making situation would necessitate an immediate resolution which would reflect the effects of the LoCL members' participation. The HiCL members would be more adaptable to a structured situation than the LoCL members would be to an unstructured situation. Since HiCL members are able to handle more uncertainty in a situation, and since the information processing behaviors of HiCL members encompass the processes required in decision-making, HiCL members should exhibit more uncertainty in their functioning by assuming different roles at different times. The uncertainty in the functional role structure (the amount of uncertainty in the group information processing structure), therefore, was predicted to increase as the PMHCL in the group increased.

Hypothesis II: Groups in which the members are all of a HiCL (100 PMHCL) generate more interpersonal conflict than groups in which the members differ in conceptual level.

Individuals of a high conceptual level generate diversity and conflict in their processing of information (Schroder, Driver, & Streufert, in press). As Schroder and Harvey (1963) report, functioning at a high conceptual level, with concomitant generation of conflict, has been noted by several authors, although the terminology used in the descriptions has been different in some instances. Bennis and Shepard (1956) have observed that following the phase concerned with mutuality and reciprocal understanding among group members, the groups moved on to a phase in which conflict, undisturbingly present, was generated from a delineation of substantive issues. For HiCL members, "...reality is defined as being possessed of multiple alternatives and hence diversity is sought as a means of enhancing validation. The system is actively sensitive and open to a more refined and wider band of the impinging world, owing to the greater complexity and richness of the internal standards or schemata from which the

environment is defined and read" (Schroder & Harvey, 1963, p. 150). If heterogeneous groups (members differ in conceptual level) with a low PMHCL exhibited conflict to an extent comparable to that of groups homogeneously composed of HiCL members (100 PMHCL), the conflict would be a result of the great deal of exploration and generation of alternatives of which LoCL individuals are capable. Group members with a low level of conceptual structure, however, are not able to evaluate alternatives as extensively as HiCL members and are not able to perceive as accurately the amount of uncertainty being generated in a situation; hence, there exists the capacity to generate diversity in the absence of a tendency to maintain diversity at an optimum level for the particular level of information processing.

Hypothesis III: The extent to which generated conflict is utilized in the synthesis of decisions increases with an increasing PMHCL in the group. With an increasing PMHCL, there is increasingly more synthesizing of generated alternatives and evaluating of alternatives during the decision-making process.

The second and third hypotheses are interdependent since the capacity to synthesize alternatives effectively is concomitant with the capacity to tolerate diversity and conflict in the generation of alternatives. Group functioning, at a high conceptual level, involves a personal mutual synthesis and a development of problem solving skills; a group in which all of the members are of a high conceptual level acts as an effective integrative instrument (Martin & Hill, 1957), in which there is utilization of differences and collaboration among members (Hearn, 1955). As Schroder and Harvey (1963) have stated, group functioning, at a high conceptual level, is characterized by a consensus which is the result of rational discussion rather than a compulsive attempt at unanimity.

In groups comprising predominantly LoCL members, the development of a hierarchical group structure prevents fluidity of the functional role structure

and minimizes the possibility of there being conflicting and divergent alternatives generated, or at least evaluated. Schroder and Harvey have suggested that although there may be generation of alternatives by LoCL members, the LoCL members do not have the ability to integrate the differentiations into a reliable and effective set of constancies or criteria for consistent definitions and actions. Since LoCL individuals, unlike HiCL individuals, are not characterized by the ability to make multiple discriminations, or to assume different perspectives in regard to given information, the prediction was made that the HiCL members would be more active in the functional role of evaluating during group decision-making.

Hypothesis IV: The extent of search for novel information increases as the PMHCL in the group increases, whereas total information search is not dependent upon group composition. The total information search in the predecisional processes, for LoCL members, is either comparable to or greater than that for HiCL members, but the search for specifically novel information is more extensive for HiCL members than for LoCL members.

Since HiCL members are able to cope with more uncertainty, to generate additional information from that already in memory storage, and to utilize a more complex dimensional structure in the perception of the environment (Schroder, Driver, & Streufert, in press), the prediction was made that HiCL members would exhibit less extensive searching for information. Lanzetta (1963) has explored the relationship between environmental uncertainty and information search behavior, suggesting that information search is elicited by a response conflict engendered by response uncertainty; the greater the degree of uncertainty, the stronger the conflict and the stronger the instigation to search. Intuitively, it would seem that individuals seek information until they reach some optimal level of uncertainty, at which they make a decision, the level being a function of the level of initial uncertainty, the rate of uncertainty reduction, and the

level of the conceptual structure. The inability of LoCL members to cope with higher levels of uncertainty would tend to require more extensive information search before decisions would be made. An increase in the level of conceptual structure provides an increase in the ability to generate more kinds of information about an environment; generation of additional information from the information already in storage would be reflected in a lower level of search activity. Moreover, as the pool of available information increases, the value of acquiring further information decreases while the value of processing-time increases (Irwin & Smith, 1957), particularly for those groups in which all participants are active in information processing. If groups with a high PMHCL are able to generate additional information from the information already available, their pool of useful information would be expected to increase more rapidly than that of the groups with a low PMHCL. The amount of information considered relevant in the immediate memory, the difficulty involved in understanding and synthesizing new information, and the ability to process data and search the memory should effect the relative priority an organism places on acquisition of additional data versus the processing of stored data. Consideration of the conceptual structures would lead to the conclusion that groups with a high PMHCL should tend to place priority on the processing of stored information.

Groups with a lower PMHCL should seek more environmental information since LoCL members tend to be less sensitive to increases in loads detrimental to information processing and tend to filter out much of the incoming information (Schroder, Driver, & Streufert, in press); these characteristic behaviors are interpreted as meaning that the input-output efficiency for LoCL members is not substantial; hence, the extent of total information search by LoCL members may be comparable to that by the HiCL members, but there is not an equally effective utilization of information in both instances.

Stager and Kennedy (1965) found that information search was inversely related to an increasing PMHCL in the group when there was an absence of imposed explicit costs for information search, but directly related to an increasing PMHCL with imposed explicit costs. A differential decrease in the level of total information search (groups with a higher PMHCL exhibited little change in the level of information search whereas groups with a lower PMHCL exhibited a marked decrease), in the latter condition, suggested that there was a critical amount of information necessary for different levels of conceptual structure. A finding (Suedfeld & Streufert, in press), which is possibly related to the observed differential decrease, is that the proportion of novel to total information requests was significantly higher for HiCL members than LoCL members; the latter, while making a higher proportion of information search moves than HiCL members, were primarily concerned with receiving feedback about ongoing activities. In contrast, the HiCL members searched for information about new, previously unexplored, aspects of the situation. The finding provides a basis for the interpretation of the effects of imposed search costs; the lesser decrease in the level of search activity, by groups comprising a higher percentage of HiCL members, may be taken to indicate that the LoCL members decreased their level of search by omitting information about relatively less critical aspects of the environment when search costs were imposed; whereas the HiCL members were primarily concerned with only novel or necessary aspects under both cost conditions.

METHOD

Subjects

Subjects were 80 Princeton University male undergraduates and graduate students. The Ss were selected from among approximately 500 volunteers on the basis of the measures subsequently described.

Subject selection and group composition

Selection

The Ss were given the following selection tests:

(a) The Paragraph Completion Test of Conceptual Level (Schroder, Driver, & Streufert, in press). The Paragraph Completion Test is a projective test of several sentence stems designed for the assessment of the level of conceptual structure. On the basis of previously acquired norms, Ss were classified as low in the level of conceptual structure (LoCL) if they obtained scores of three or less, and high in the level of conceptual structure if they obtained scores which were greater than seven.

(b) The nDominance Scale of the Edwards Personal Preference Schedule (Edwards, 1959). The need-for-dominance items reflect the desire to be a leader, to give advice, to make decisions, and to defend one's own position. For purposes of comparison, the scale was administered in the same form as used by Tuckman (1966); in order to reduce the visibility of the scale, it was given with the nAffiliation scale of the Edwards Personal Preference Schedule and the items from the two scales were interspersed. nDominance scores were converted to quartile scores, based on norms derived from a sample of approximately 200 individuals; Ss were classified as high on nDominance if they scored in the highest quartile, intermediate if they scored in either of the two intermediate quartiles, and low if they scored in lowest quartile. This breakdown was used since the research design required one-half of the Ss to be intermediate on this measure, with half of the remaining Ss high and the other half low.

Group composition

Those Ss classified as high or low in the level of conceptual structure by the conceptual level measure were considered for further selection; all others were rejected. There was no difference in the levels of intelligence, as measured by the Wonderlic Personnel Test, between the HiCL and LoCL Ss. The Ss were further subdivided into high, intermediate, and low nDominance groupings. Twenty four-man groups were composed to yield four combinations of conceptual level. Each of the four compositions was represented by five groups. The group compositions were defined with respect to the dimension of an increasing percentage of members of a high conceptual level (PMHCL) in the group. The homogeneous composition comprised four members who were of an equally high conceptual level (100 PMHCL). The other types of compositions comprised groups in which three (75 PMHCL), two (50 PMHCL), or one (25 PMHCL) of the members, in each type of composition respectively, had a high level of conceptual structure. The groups, therefore, were considered as being equally spaced along the PMHCL dimension. The 100 PMHCL group was homogeneous in composition and the 25, 50, and 75 PMHCL groups were heterogeneous with respect to the conceptual level dimension. Member dominance was controlled by systematically varying the distribution of high, intermediate, and low nDominance across members of each group composition. Each group comprised one high, one low, and two intermediate nDominance members. In each instance, at least one of the high conceptual level members in the group was of intermediate nDominance. Groups were matched, as closely as possible, on intelligence.

Experimental decision environment

Each group participated in a complex simulated tactical decision-making situation (Streufert, Clardy, Driver, Karlins, Schroder, & Suedfeld, 1965). The groups were confronted with a model of an island which they were to assume

was held by an enemy force of unknown strength and location. Acting as four members of equal status on a military field staff, they were instructed to engage the enemy and to secure the island. The groups received information about the enemy movements and the effects of their own decisions by providing for acquisiton of such information through the deployment of their own forces. Responses to their decisions were provided by a preprogrammed input (Karlins, Schroder, & Streufert, 1965), which was perceived by the groups as realistically dynamic and responsive. The fixed input program was initially designed for the purpose of providing a controlled and standardized input of information to Ss participating in the tactical situation. The duration of the tactical decision-making situation comprised seven half-hour periods.

Coding and rating scales

The coding and rating forms used by the observers are presented in the Appendix. Preceding the experiment, a coding scheme was derived and found, after continuous refinement, to yield reliable functional-categorization of individual and group behavior. The final coding and rating scheme was prepared in the form of a manual (see Observer's Manual - Tactical Environment in the Appendix) which could be used by the observers.

Verbal behavior of the groups was coded according to the predefined categories of perceiving and proposing the problem, requesting information, supplying information, suggesting alternatives, evaluating alternatives, autocratically deciding, and confirming decisions through consensus. Each category was considered as a functional role in the decision-making process; scoring, therefore, was concerned with the changes of a group member from one role to another. In order to provide additional analyses, the frequencies with which (a) new or novel information search was requested, (b) different alternatives were proposed, or (c) evaluations of different alternatives were given, while members were in the respective functional roles, were noted.

Individual members were rated on the extent to which their overt behavior was synergistic or facilitating, empathic with respect to the enemy, and conceptually integrative. Groups were rated with respect to their utilization or synthesizing of informational diversity, their generation of diverse and conflicting alternatives, the number of effective communication channels available in the group, and the type of emergent group structure.

The reliability of the coding and rating, across all of the measures, based on the assessments of two trained observers, ranged between 0.79 and 0.96 for the first eleven experimental groups. The median reliability coefficient, 0.91, was taken as justification for the assumption that observations by a single observer would be reliable for the remaining nine groups.

Procedure

Each of the twenty four-man groups participated in the tactical decision-making situation with the assumption that the enemy was represented by another group. The group interaction, generated by the task, was tape-recorded and observed through one-way observation screens. Each member's participation was recorded by means of individual throat microphones connected to separate tape-recorders. During the three-and-one-half-hour session, the group interaction was coded continuously according to the described categories or functional roles. Groups were rated, at the end of each half-hour session, on the behaviors previously listed. Each of the orders drafted and submitted by the groups was retained for further analysis.

RESULTS

Group structuring

The Shannon measure of average uncertainty, described by Garner (1962) was applied to the frequency distribution of functional roles for each group member. The computed uncertainty (H) for a given member was then combined with the uncertainty computed for the other members of the group, thus yielding a value for the total uncertainty in the group. Figure 1 presents the mean values for each type of group composition. An analysis of variance indicated that the composition effect was significant ($F = 12.93$; $df = 3,16$; $p < .001$); the increase in uncertainty, with an increasing PMHCL, was significantly linear (with trend analysis yielding $F = 37.3$; $df = 1,16$; $p < .001$). The trend analyses applied to the data for the different dependent variables assumed equal distances between the different compositions. This was a defensible assumption since the different compositions were derived by replacing one additional LoCL member with one HiCL member at the successive intervals along the PMHCL dimension. Since the group uncertainty (total H value) was derived from a summation of individual values (an analysis at the individual level), a second metric for group structuring was applied to the data. A more direct assessment of structuring was obtained with the role centrality index (Hutte, 1965), which indicated the degree of functional role centrality present in the group. The centrality index is a value between one and zero which indicates the extent to which only one member assumed a given functional role (indicated by an index value of one), or all of the members assumed a given functional role equally often (indicated by an index value of zero). For each group, the centrality indices for each functional role were summed across the different roles, thus yielding a total structural index (an analysis at the group level). As illustrated in Figure 1, the uncertainty measure H and the structural index appeared to provide comparable assessements

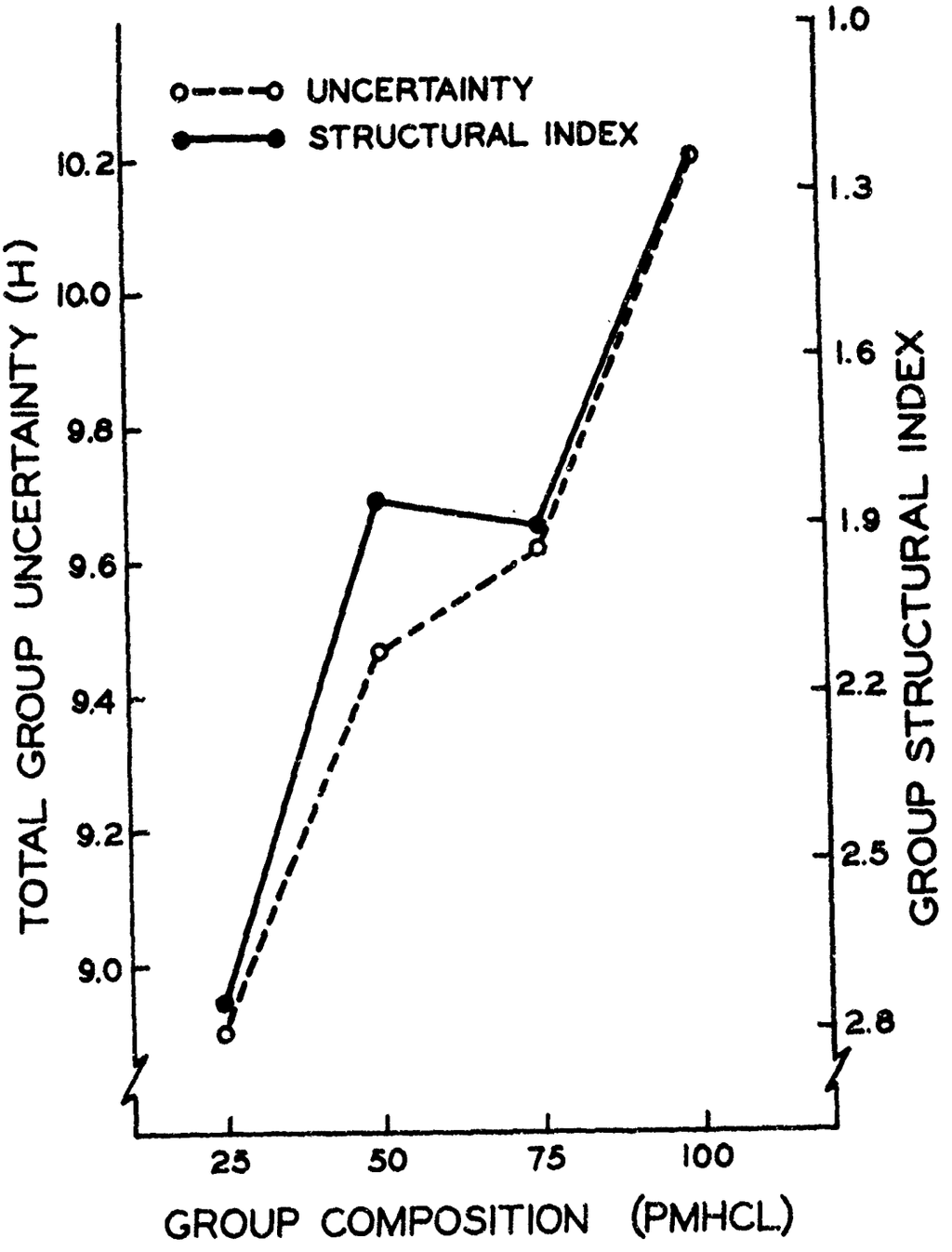

FIG. 1. Group uncertainty (H) and structural index as functions of an increasing PMHCL in the group.

of the degree of group structuring. The composition effects were significant ($F = 4.53$; $df = 3,16$; $p < .05$), the increase in group structuring (as measured by the structural index), with an increasing PMHCL, also being significantly linear ($F = 17.6$; $df = 1,16$; $p < .001$).

Total group structuring, as reflected in the total structural index, correlated significantly ($p < .01$; $df = 18$; one-tailed test) with group uncertainty H ($r = -0.616$), and rated group structure ($r = -0.637$). Ratings of group structure, based on the definitions used by Tuckman (1964), were found to be subject to composition effects ($F = 30.03$; $df = 3,16$; $p < .01$); the differences between groups of 100 PMHCL and 50 PMHCL, 100 PMHCL and 25 PMHCL, and 75 PMHCL and 50 PMHCL contributed (at the 0.01 level) to the overall significance of the composition effects.

HiCL Ss alternated between different functional roles, within their respective groups, more frequently and exhibited significantly greater role uncertainty (H) than LoCL Ss ($t = 4.99$ and 9.09, respectively; $df = 78$ and $p < .01$ for the one-tailed test in both instances). Analysis of the total number of role changes within each group, however, did not indicate that there were significant composition effects present.

Interpersonal conflict and conflict utilization

Composition means derived from rated interpersonal conflict and utilization of conflict in the process of decision-making are presented in Figure 2. The degree of interpersonal conflict was curvilinearly related to group composition, (a quadratic trend analysis yielding a significant $F = 13.0$; $df = 1,16$; $p < .01$); the rated utilization of generated conflict increased linearly (linear trend analysis $F = 66.3$; $df = 1,16$; $p < .001$), with an increase in the PMHCL in the group. Analysis of variance indicated that the composition effects for interpersonal conflict were significant ($F = 4.71$; $df = 3,16$; $p < .05$); the homogeneous

(100 PMHCL) groups generated significantly more conflict ($p < .05$ in post-hoc comparison of means) than any of the other compositions. Similarly, composition effects, with respect to the utilization of generated conflict, were significant ($F = 23.78$; $df = 3,16$; $p < .01$).

Generation of suggestions or alternatives did not vary significantly with different group compositions; the number of evaluations, however, and hence, the ratio of suggestions to evaluations (S/E), were subject to composition effects (Figure 3). Analysis of variance yielded a significant F in both instances (evaluations; $F = 3.38$; $df = 3,16$; $p < .05$; S/E ratio; $F = 15.95$; $df = 3,16$; $p < .01$). A trend analysis indicated that the S/E ratio involved both linear and quadratic components ($F = 135.0$ and 8.3; $df = 1,16$; $p < .01$ and $.025$, respectively); the number of evaluations increased linearly ($F = 9.92$; $df = 1,16$; $p < .01$), with an increasing PMHCL. Figure 3 also illustrates the linear increase in the complexity of group communication (linear trend $F = 10.1$; $df = 1,16$; $p < .01$) that occurred as the PMHCL in the group was increased. Rated communication complexity or, alternatively, openness of communication channels, correlated significantly ($p < .01$; $df = 18$) with the rated utilization of generated conflict ($r = 0.951$), the S/E ratio ($r = - 0.665$), and the number of evaluations made by the group ($r = 0.531$). Total group structuring (structural index) also correlated significantly ($p < .01$; $df = 18$; one-tailed test) with the S/E ratio ($r = 0.592$) and the rated utilization of conflict ($r = -0.631$). The partial correlation coefficient for group structure (structural index) and the S/E ratio, with the effect of communication removed, was not significant ($r = 0.218$). A variance interpretation of the coefficients indicated that some 86 percent of the association of the latter three variables resulted from the effect of communication. Communication ratings correlated significantly with the total group structural index ($r = -0.699$) and group uncertainty ($r = 0.729$).

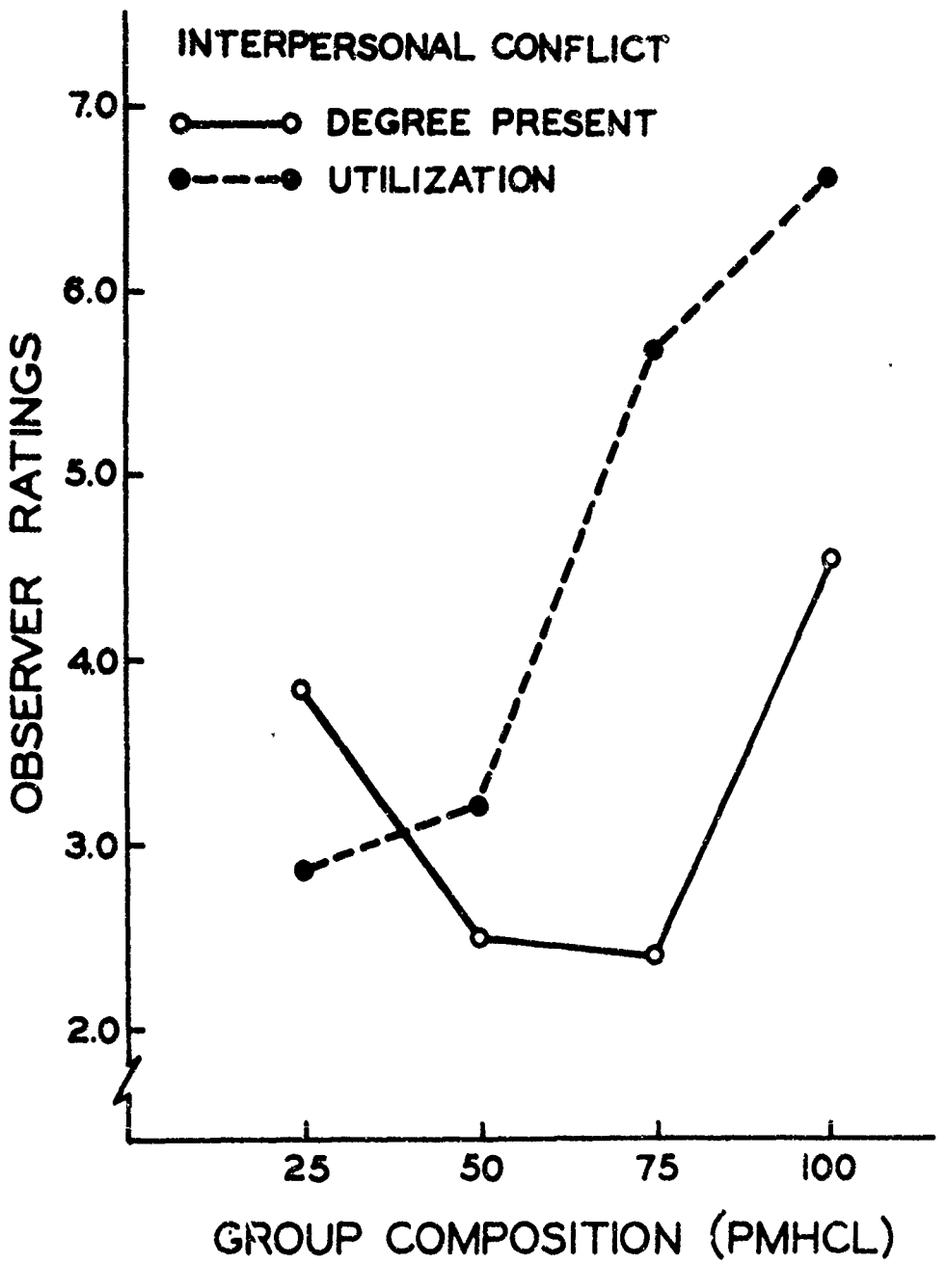

FIG. 2. Rated interpersonal conflict and conflict utilization as functions of an increasing PMHCL in the group.

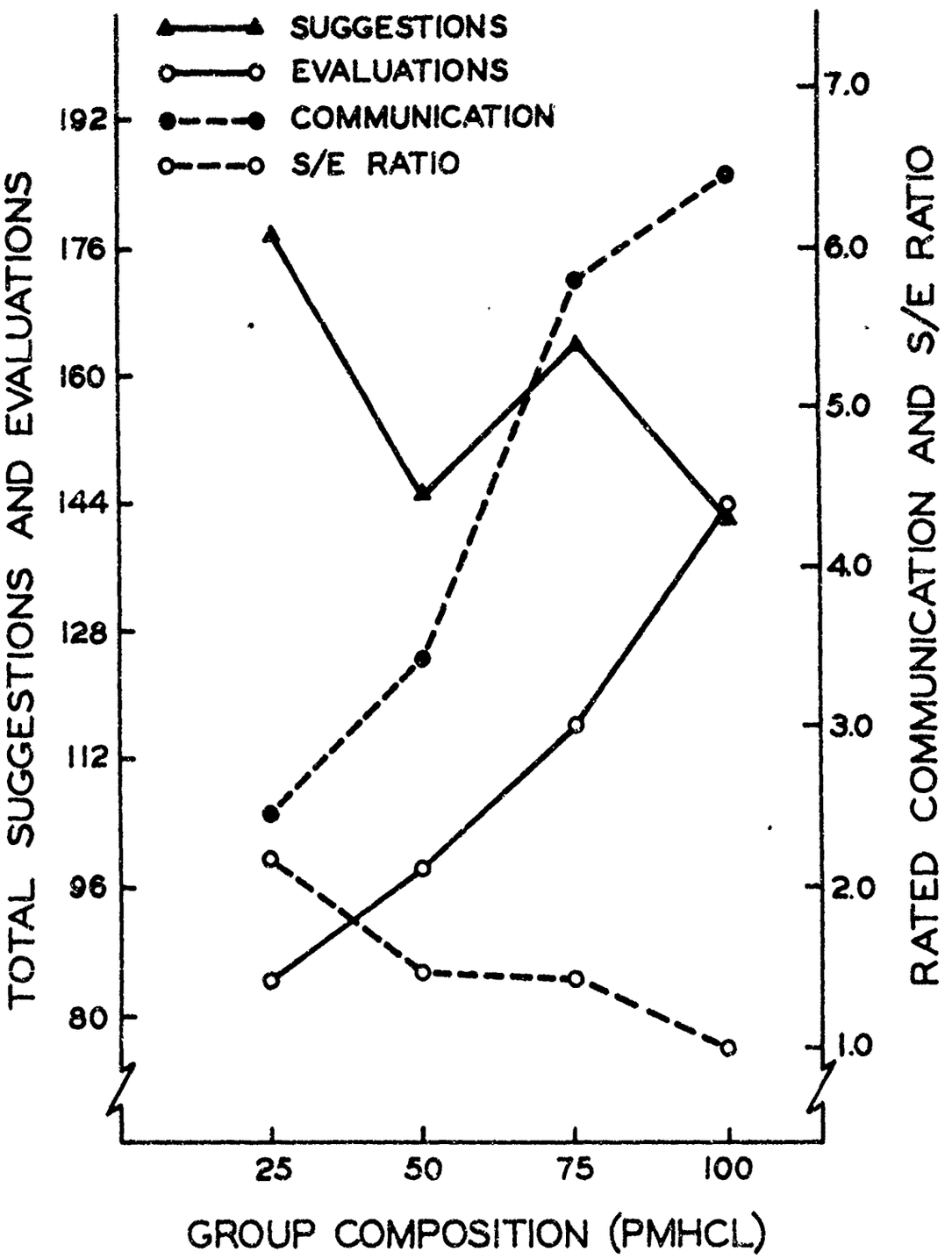

FIG. 3. The effect of an increasing PMHCL in the group on the generation of alternatives, evaluation of alternatives, communication complexity, and S/E ratio.

Information search

A number of measures were applied to the data concerning group information search. As in the case of the group information processing structure, two measures, one derived from an analysis at the group level and one from an analysis at the individual level, were used to assess group search for specifically novel information (Figure 4). A direct assessment was obtained by determining the number of information search orders which were actually submitted by the groups. As illustrated in Figure 4, the number of orders increased in a linear manner (linear trend $F = 14.0$; $df = 1,16$; $p < .01$) across the various compositions. Composition effects were significant ($F = 5.41$; $df = 3,16$; $p < .01$).

The second assessment was obtained by combining the frequencies with which different members in a group requested novel information; the assessment included proposals by the members for the group to take some kind of action which would provide novel information. The second assessment, therefore, indicated the propensity within the group for information search, rather than the actual execution of information search orders. Again, composition effects were significant ($F = 3.46$; $df = 3,16$; $p < .05$). Although the combined frequencies increased linearly (trend analysis $F = 7.4$; $df = 1,16$; $p < .025$) with an increased PMHCL, a comparison of the group means indicated that the significance was attributable to the difference between the mean of the 100 PMHCL groups and the average of the means for the other compositions (Figure 4). The relationship of the number of information search orders (novel information), expressed as a proportion of the total number of orders submitted, is illustrated in Figure 4.

For purposes of assessing the total information search in the groups, the frequencies, with which the functional role of requesting information was assumed,

were summed across the group members; no significant differences between the various compositions were obtained. When considered independently of their respective groups, the HiCL Ss were found to have requested significantly more novel information than the LoCL Ss ($t = 3.67$; $df = 78$; $p < .01$; one-tailed test); there was not a significant difference between the frequencies with which the HiCL or LoCL Ss assumed the functional role of requesting information.

The functional role of proposing and structuring the problem decreased in centralization (the centrality index decreased) as the PMHCL increased ($F = 3.95$; $df = 3,16$; $p < .05$). Concomitantly, the HiCL Ss assumed the role of problem structuring more frequently than the LoCL Ss ($t = 9.28$; $df = 78$; $p < .01$; two-tailed test). None of the remaining functional roles showed significant composition effects with respect to the indices of centralization.

In the course of group interaction, HiCL Ss were rated significantly more synergistic in their attempts to synthesize decisions, as being more aware of the enemy's alternatives (empathic), and more integrative (conceptually integrative) in deriving alternatives than LoCL Ss ($t = 10.45$, 10.78, 11.09, respectively; $df = 78$; $p < .01$).

The control variable of nDominance did not correlate significantly with any of the dependent variables in the case of LoCL Ss. Member nDominance for HiCL Ss, however, correlated (beyond the .05 level) with eight out of eleven of the dependent variables (Table I).

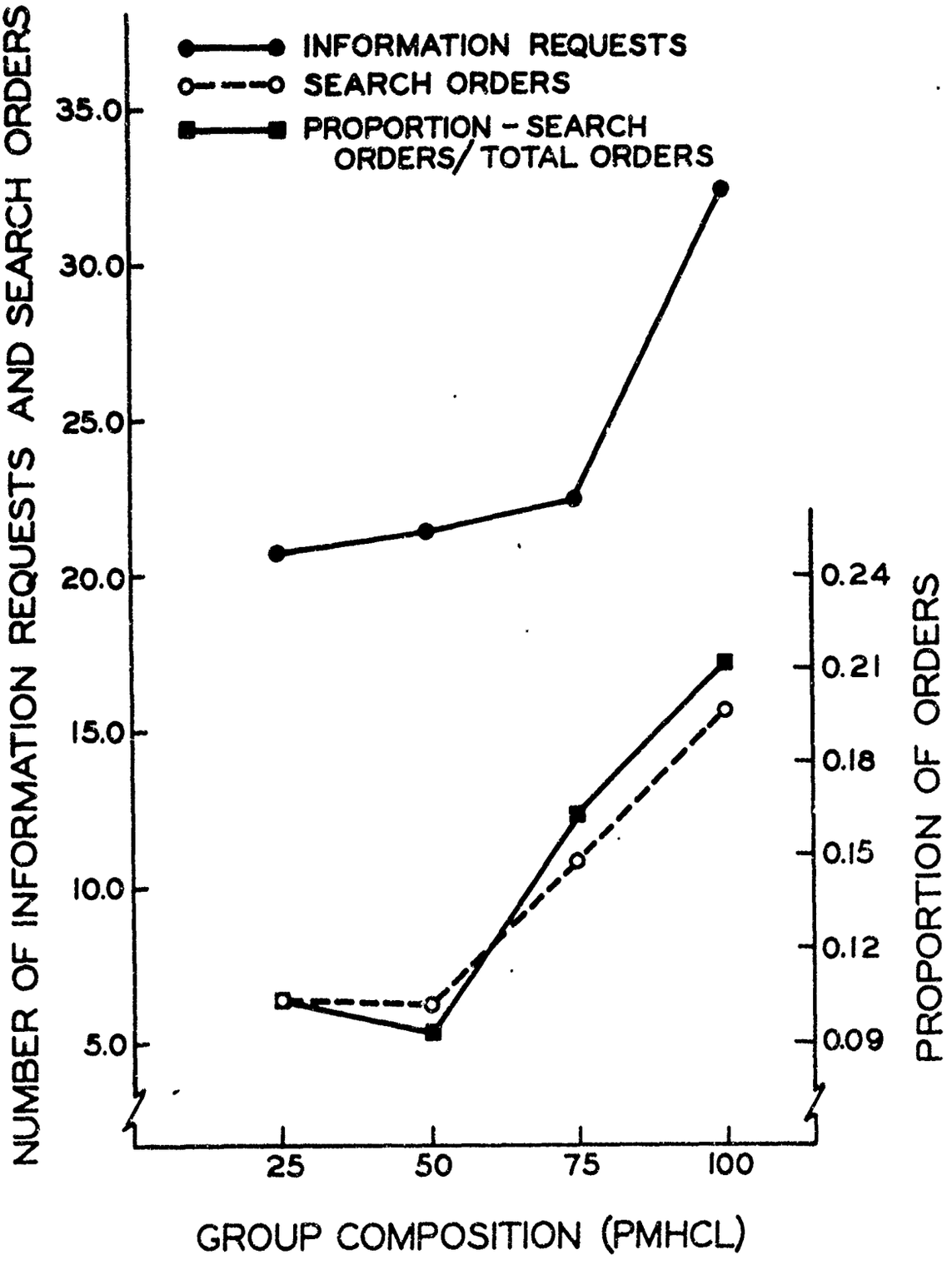

FIG. 4. Information requests, search orders, and proportion of search orders for novel information as functions of an increasing PMHCL in the group.

TABLE I

Correlation of nDominance with Functional Role Activity

Variable	LoCL Ss		HiCL Ss		Ss Combined	
Role Assumed and Related Activity	r	p[a]	r	p[b]	r	p[c]
Propose Problem	0.134	ns	0.156	ns	0.101	ns
Request Information	-0.082	ns	0.246	ns	0.152	ns
Supply Information	0.233	ns	0.386	.01	0.319	.01
Propose Alternative	0.049	ns	0.486	.01	0.367	.01
Evaluate Alternative	0.024	ns	0.485	.01	0.308	.01
Decide Autocratically	0.036	ns	0.395	.01	0.299	.01
Seek Consensus	-0.044	ns	0.326	.05	0.235	.05
Search New Source	-0.119	ns	0.196	ns	0.107	ns
No. Alternatives	-0.139	ns	0.453	.01	0.269	.05
No. Evaluations	0.088	ns	0.414	.01	0.275	.05
No. Role Changes	0.013	ns	0.470	.01	0.325	.01

a. Two-tailed test with df = 28

b. Two-tailed test with df = 48

c. Two-tailed test with df = 78

DISCUSSION

Group structuring

The results confirmed the hypothesis (I) that group structuring and role differentiation decreases with an increasing PMHCL in the group. Comparable assessments of group information processing structure were obtained with the functional role uncertainty (H) and role centrality (structural index) procedures. Additionally, the present observations provide support for the informal suggestion that role differentiation is facilitated in the 75 PMHCL group, thus enhancing the level of performance on tasks which require some degree of group structuring as well as an optimal level of information processing. Groups which comprise an equal number of LoCL and HiCL members may, however, have difficulty in achieving a stable structure. As illustrated in Figure 1, the two assessment procedures yielded the least comparable assessment for the 50 PMHCL groups; total structuring was shown to be somewhat less (a lower structural index) for the 50 PMHCL than for the 75 PMHCL groups, although the difference was not significant.

The obtained increase in role differentiation, with a decrease in the PMHCL, is consistent with Tuckman's (1966) finding: groups, heterogeneous in conceptual level and heterogeneous in member nDominance, manifested greater role differentiation than groups which were homogeneous in conceptual level and heterogeneous in nDominance. The difference in role structuring was reported to have been similar for different task-demands. Streufert and Schroder (in press) have suggested, however, that increasing the information load placed on small decision-making groups results in increased diversification of attention, particularly in groups comprising LoCL members; in other words, each member attends to particular portions of the environment. Information load, as a characteristic of the environment, may operate to induce one kind of structuring.

Since the focus of the present study was upon group processes, the relation of the observed group functioning to group performance is uncertain. Previous research, however, provides a basis for extrapolation. French (1951), for example, noted that equal participation of group members was positively related to group performance; a negative relationship existed between the degree of centralization and the level of performance. Similarly, Hutte (1965) has recently reported that groups performed more effectively when there was less leadership in regard to decision-making. High performance and centrality of decision-making were not compatible. Guetzkow's (1960) analysis of role differentiation and emergence of interlocking structures was based upon research involving communication nets. Effective performance in the various communication designs required role differentiation and, more importantly, the development of an interlocking organizational structure in the system; but as Hutte has pointed out, the communication-net research has been characterized by a topological channeling of information -- a factor which is not present in the approach taken by Hutte or the present study and which may be one determinant of performance differences.

The underlying concept here, however, is that different environmental variables require different structural responses if a high level of performance is to be maintained across environments. In the present decision-making situation, which did not require a structured organization, the groups responded to the environment with increased structuring as the PMHCL in the groups decreased. Since a distribution, rather than a centralization of "executive" functions is relatively more effective for decisions in which response effectiveness is determined by the external state of the environment (Roby, Nicol, & Farrell, 1963), the 100 PMHCL groups appear to have responded appropriately. Granting that the environment partially determines the structuring of the group, the conceptual level of the members is probably limiting factor. The need for

a low level of uncertainty, on the part of LoCL individuals in a complex environment, is reflected in the reduction of uncertainty with respect to differentiation and centralization of functional roles.

Socialization is dependent upon the training conditions to which the individual is exposed (Schroder, Driver, & Streufert, in press); the interdependent training conditions, which are conducive to the development of a high level of conceptual structure, perhaps equip the HiCL individual with the capacity to function easily and efficiently in the different functional roles which are involved in decision-making. Miller (1963) has recently noted the position taken by Brim (1960) who proposed that the inadequately socialized person may not exhibit functional role flexibility because ne is unable to discriminate between roles and lacks the skills for meeting role requirements in certain situations. The ability of the individual to assume different roles at different times is perhaps most clearly observed in leadership behavior. Intuitively, group leadership would seem to involve a number of functional roles; granting the complexity of the concept, the leadership role (assessed by rated leadership) shifts from one group member to another more frequently in groups comprising members who are all of a high conceptual level than in groups comprising members who are all of a low conceptual level (Schroder, Streufert, & Weeden, 1964).

The absence of a centralization of functional roles or, conversely, the presence of role uncertainty, when accompanied by a high level of performance, presupposes a condition of symmetrical facilitation (Thomas, 1960) by means of which the contributions of the members are mutually facilitated and continuously integrated. Integration and facilitation are concomitant with accuracy of the members' social perception (Steiner & Dodge, 1956), which is effective, moreover, only in the absence of a role system. Members, in order to function effectively, require the freedom and the ability to adjust their own behaviors in response to

their perception of various aspects of the group interaction, without being restricted to certain roles within an emergent system. The ability to perceive and readily adjust to environmental changes has been ascribed, theoretically, to HiCl individuals who are also characterized by the absence of any marked tendency to create structure in a system.

The limitation which a functional role system places on a group member's range of behavior might be inferred from the results concerning the relationship between the control variable, nDominance, and the functional role activity (Table I). The control variable of nDominance did not correlate significantly with any of the dependent variables, in the case of LoCL Ss; this fact suggests that the effects which the nDominance variable might have had on functional role participation were masked by the more influential variable of functional role structure, particularly in the low PMHCL groups. In the case of HiCL Ss, member nDominance correlated with the amount of activity in the functional roles, with the exceptions of the extent of searching for novel information and the frequencies with which the functional roles of problem structuring and requesting information were assumed; this suggests that the effect of member nDominance on participation in different roles was not limited by the effect of functional role structure. The latter effect would have decreased as the PMHCL in the groups increased. With a decrease in the PMHCL in the groups, the increase in structuring would appear to affect the contribution of a given personality variable in determining behavior within the group.

The behaviors associated with the functional roles of problem structuring, requesting information, and searching for novel information appear to be determined by an individual's conceptual level; the behaviors were not correlated with the nDominance variable (in the case of either HiCL or LoCL Ss) and were found to be a function of conceptual level.

Interpersonal conflict

The results of the present study confirmed the hypothesis (II) that groups, in which all of the members are of a high conceptual level (100 PMHCL), generate more interpersonal conflict than groups in which members differ in conceptual level. As tentatively suggested, the heterogeneous groups (members differ in conceptual level) with a low PMHCL exhibited extensive conflict although less than the groups homogeneously composed of HiCL members (100 PMHCL); consequently, intragroup conflict was found to be curvilinearly related to the PMHCL dimension. The generated conflict was partly a function of the number of alternatives generated by the group; more importantly, however, conflict was a function of the degree to which a given alternative was perceived as being different from previously proposed alternatives. Both of these functions were operating in the 100 PMHCL groups. Since HiCL members are not only better able to make finer discriminations of incoming information, but also process the resultant discrepant bits of information, conflicting alternatives were accommodated by the 100 PMHCL groups. Attempts, on the part of the members, to support their proposals, contributed initially to a heightened degree of conflict. The conflict in the 25 PMHCL groups, however, involved the members' ability to generate several alternatives and their inability to resolve perceived discrepancies. Conflict resolution was attempted through persistent efforts, on the part of the members, to have their respective proposals accepted; the various alternatives were seldom assessed by other members or by the members responsible for them. The present observations are consistent with the description of functioning at a low conceptual level (Schroder, Driver, & Streufert, in press).

The relatively lower level of interpersonal conflict, which characterized the 50 and 75 PMHCL groups, appeared to be attributable to the need of the respective members to suppress intragroup differences and to arrive at a decision with as little concomitant diversity of opinion as possible. Although

the 50 PMHCL groups were expected to suppress conflict, the similarity of the two intermediate compositions would not have been expected in view of the greater capacity for evaluation which resided in the 75 PMHCL composition.

The present results are inconsistent with those reported recently by Tuckman (1966). On a complex decision-making task, groups homogeneously composed of HiCL members (100 PMHCL) exhibited less conflict than heterogeneous three-man (66 PMHCL) groups. Groups, in which all of the members were of a low conceptual level, exhibited more conflict than 33 PMHCL groups (heterogeneous groups in which only one of the three members had a HiCL). Tuckman suggested that the presence of a HiCL member, among LoCL members, functions to reduce conflict, possibly by facilitating the emergence of a fixed structure; the presence of a LoCL member, among HiCL members, creates conflict by combining a structure-oriented individual with members who are information oriented. The extensive conflict in the 25 and 100 PMHCL groups in the present study is suggested to be a function of the structuring which occurs in the groups, but, more fundamentally, a consequence of the differential information processing capabilities which result in distinctly different group information processing structures and decision processes.

Evaluation of alternatives

The hypothesis (III) that the extent to which generated conflict or diversity of information is utilized, in the synthesis of the decision, is directly related to the PMHCL in the group was confirmed by the results. Groups comprising only HiCL members exhibited significantly more extensive synthesizing of generated alternatives and more extensive evaluation of suggested alternatives than the heterogeneous groups. The conclusion is comparable to that drawn by Tuckman (1964); groups in which all of the members were of a LoCL used decision mechanisms which eliminated the possibility of diversity being utilized; groups in which all

of the members were of a HiCL (100 PMHCL) used decision mechanisms which fostered diversity and which enabled diversity to be utilized. Tuckman's more recent paper (1966) indicates that for the most effective performance there is an optimal amount of diversity which can be generated. Assuming that the level of conflict in the group depends upon the group composition, then the level of conflict deriving from the composition might create an overload in diversity and, hence, reduce the level of information processing. In Tuckman's (1966) study, the replacement of one of three HiCL members with a LoCL member did result in a heightened degree of conflict and less effective information processing. In view of the present results, however, it would appear necessary to make a distinction between diversity and conflict. The 75 PMHCL groups, for example, proposed more alternatives (diversity) but generated less conflict than the 100 PMHCL groups. Although there was no assessment of performance in the present study, the source of the overload (which would be detrimental to performance) would appear to be in the number of alternatives generated rather than the level of conflict. Whereas the 75 PMHCL groups may have generated a superoptimal level of diversity, the 100 PMHCL groups appear to have generated a more optimal level and maximally utilized the conflict which was derived from the diversity. Effective information processing and performance would appear to be dependent upon the ability of the group to (a) generate a level of diversity which is optimal for the conceptual level of the members, (b) generate an optimal level of conflict based on the diversity generated, and (c) utilize the conflict in synthesizing decisions. Since the 75 PMHCL groups appear to have generated a relatively superoptimal level of diversity and a suboptimal level of conflict the performance level of the groups would be relatively lower than that of the 100 PMHCL groups, assuming that the 100 PMHCL groups generated optimal levels of diversity and conflict.

The structural characteristics of the group, which would facilitate evaluation and synthesis have been suggested in the discussion concerning group structuring and role flexibility. Reference has been made to the suggestion that hierarchical structuring prevents fluidity and limits diversity generation and integration (Schroder & Harvey, 1963). Although the number of alternatives proposed was not dependent upon group composition, the frequency with which evaluations were made increased with a decrease in group structuring. Figure 3 clearly illustrates the processes which were operative in decision synthesis. The increase in evaluating, with a decrease in group structuring, was paralleled by a linear increase in the group communication channel complexity. A multichanneled communication network would be expected to contribute to the facilitation of reciprocal evaluations. Communication complexity consistently correlated highly with the rated utilization of conflict, the frequency of evaluation, and (negatively) with the S/E ratio. Although group structuring also correlated highly with these variables, the association was primarily attributable to effects of communication complexity. It would seem that flexibility of functional role structure is a necessary but not a sufficient requirement for effective decision-making; an openness to multiple sources of information is required on the part of each member.

Research by Triandis indicates that a similarity in cognitive structure facilitates communication (Triandis, 1960a, 1960b; Triandis, Hall, & Ewen, 1965). A higher level of synergism in the group (which was characteristic of the 100 PMHCL groups) would also tend to foster communication and, hence, reciprocal evaluation. Although the HiCL members, generally, tended to be more synergistic than the LoCL members, the contributions by the HiCL members to the level of information processing and decision synthesis was limited by the group information processing structure in their respective groups. The effect of participation and communication (Blake & Mouton, 1961) on emergent decisions (Hall,

Mouton, & Blake, 1963) has often been emphasized; the more optimal decisions result when the group members are able to freely contribute information, ideas, and opinions and to have them evaluated (Torrance & Ziller, 1958).

Another factor, which could be involved in the decrease of the S/E ratio with an increase in the PMHCL, is the tendency of LoCL individuals to consider single rather than multiple alternatives, particularly during periods of stress. This type of information processing provides a means of simplifying a situation to the point where action is possible, thus avoiding the complexity involved in the consideration of multiple alternatives; however, the selection of relatively fewer alternatives for evaluation results in there being a more narrow scale of judgement (Ziller, 1955), defined as the range of alternatives available to the group, and less effective decision-making.

Decision-making has been shown (Hutte, 1965) to be more effective when there is less centralization in the group and when the exchange of evaluations is relatively higher than the exchange of substantive data. The more each member facilitates evaluation, the higher the level of group performance. Since centralization of functional roles decreased and the extent of evaluating increased with an increase in the PMHCL in the group, decision-making should increase in effectiveness as the PMHCL increases. Hutte also found that there was a curvilinear relationship between the number of alternatives proposed by the group and the level of performance; the relationship indicated than an optimal level of diversity was conducive to more effective performance.

The level of performance attained by a group is, basically, a function of the interaction between situational and personality variables (viz. Forehand & Von Haller Gilmer, 1964; Ware, 1964) and would seem to depend upon the extent to which the group information processing structure in the group is adaptable to the structural demands of the environment. Since various compositions of

conceptual level result in different information processing structures, the differences in levels of performance, attained by different group compositions, could be interpreted in terms of the PMHCL dimension. The group information processing structure determines the restrictions which are placed on the process of decision-making and the extent to which the group is able to utilize its resources (Lanzetta & Roby, 1960); when based on the conceptual level dimension, the variable of group composition should, therefore, be a major determinant of performance level.

Information search

The hypothesis (IV) that the extent of novel information search increases with an increase in the PMHCL in the group, whereas total information search does not depend upon group composition, was confirmed by the results. The underlying hypothesis that the total information search by LoCL members is either comparable to or greater than that by HiCL members was shown to be tenable; also, the search for specifically novel information was more extensive for HiCL members than for LoCL members.

Figure 4 presents group search pertaining to specifically novel information. The increase in the proportion of information search orders clearly paralleled the increase in the absolute number of search orders, as the PMHCL increased. Since the total number of decision orders did not significantly vary with group composition, a lower proportion of search orders for novel information would indicate that the respective groups were more redundant in their search and retaliatory in their decisions; in other words, with a decrease in the PMHCL there was a decrease in the use of long-range strategies. Informal observations would seem to be consistent with this interpretation.

The obtained increase in the proportion of novel information search orders, with an increasing PMHCL in the group, is comparable to the differences noted

in individual search by Suedfeld and Streufert (in press), but inconsistent with the results for group search reported by Streufert, Schroder, and Grenoble (1964). Suedfeld and Streufert also reported that LoCL Ss exhibited a higher total search for information than HiCL Ss, whereas no significant differences were noted in the present study; comparison of the studies, however, involves the consideration that Suedfeld and Streufert based their observations on externally directed information orders whereas the results of the present study are based on internally directed (intragroup) requests for information.

The hypotheses describing information search behavior were based on the assumption that individuals search for information in order to reduce uncertainty in a situation; the amount of information obtained is determined by the amount of uncertainty, or the amount by which the a priori uncertainty is reduced (Garner, 1962). Some intermediate or optimal level of subjective uncertainty (Berlyne, 1960; Eckbald, 1963, 1964; Schroder, Driver, & Streufert, in press), however, is more attractive than a very high or very low level.

The concept of an optimal level of uncertainty is related to the notion of a system equilibrium. As March and Simon have suggested (1958), the assumption that intrapersonal conflict or heightened uncertainty represents a disequilibrium in the system is implicit in all treatments of the phenomenon. "Perceived conflict is a function of the subjective uncertainty of alternatives, the subjective incomparability of alternatives, and the subjective unacceptability of alternatives" (March & Simon, 1958, p. 115). Where conflict is perceived, there is a motivation to reduce conflict, the specific reaction depending upon the source. Where the source is uncertainty, the individual will first increase his search for information which will clarify the consequences of alternatives already present. Alternatively, an increase in the search for new alternatives will occur. Recognition of the unacceptability of available alternatives evokes

the search activity, in this instance for new alternatives. Under stress conditions, such as information overload (Schroder, Driver, & Streufert, in press), information search becomes less efficient. For those individuals with a LoCL, particularly, search may be extremely vigorous but largely stereotyped. In other words, the search may be directed toward ongoing activities rather than sources of novel information (viz. Suedfeld & Streufert, in press).

Most decision situations contain both stimulus and response uncertainty, i.e., the decision maker must both identify the nature of the situation (stimulus uncertainty) and decide what response is appropriate for the situation (response uncertainty). In this regard, information search is more clearly related to subjective or perceived uncertainty than to objective uncertainty, since an individual's estimate of his uncertainty correlates with the probability of his searching to certainty:: the higher the perceived uncertainty, the more extensive the information search (Lanzetta & Sieber, 1964). From a theoretical point of view, persons who perceive their environment according to a low level conceptual structure perceive less information or experience less uncertainty than persons who utilize a structure of a high conceptual level. If perceived uncertainty is a determinant of information search, it would follow that information acquisition should vary as a function of conceptual level. On this assumption, LoCL members would be expected to manifest less searching. Alternatively, since the process of differentiation and integration is more difficult or less effective for LoCL members, which are also more stimulus bounded (Schroder, Driver, and Streufert, in press), information would be utilized in discrete bits and relatively more units of information would be required. Information search would appear to depend upon at least perceived uncertainty and efficacy of information processing.

In addition to the perception of uncertainty, the ability to tolerate uncertainty, which is a function of the optimal level of uncertainty in the system, must also be a determinant. The decision-making processes of HiCL members are characterized by relatively more openness to environmental ambiguity and information, leading to the examination of a larger number of alternatives, evaluation of these alternatives in terms of a variety of criteria, integration of information in order to effect the evaluation, and a tendency to remain cognizant of uncertainty and open to up-dated information even after a decision has been reached. Research has indicated that the perception of uncertainty in the situation is not consistently followed by information search, particularly under conditions stressing the importance of the decision (Lanzetta & Sieber, 1964; Sieber & Lanzetta, 1964); for example, HiCL individuals, in the latter condition, suggested that they were aware of uncertainty which they did not explore or remove, and indicated that more complex and conflicting hypotheses were entertained. For the HiCL individuals, there was a greater resultant post-decisional uncertainty in view of their decreased information search. A decrease in information search under the high importance condition indicates an increased emphasis on an extensive processing of the available information. There is the possibility of an extensive "internal" information search (viz. Lanzetta, 1963; Streufert & Driver, in press; Streufert, Suedfeld, & Driver, 1965), within the individual or within what Perlmutter (1953) has called the "group memory"; symbolic or external information processing activities may also be evoked in conditions of uncertainty.

In the presence of uncertainty, the organism may initially search across stored information for that which could provide a basis for evaluation, integration, and hypotheses of consequences with respect to emergent alternatives. If, when the internal search process is completed, relevant data or satisfactory alternatives have not been generated, then the organism may search externally

for additional information. At any stage in the process of sequential decision-making, the organism is faced with the decision to take some action on the basis of available and processed data, to re-enter the memory search phase and re-process stored data, or to acquire additional information which must, in turn, be processed if alternative strategies are to be formulated.

In addition to the factors already mentioned, there is evidence which indicates that the cost of the predecisional processes, the cost of acquiring and screening information, is probably a determinant of when these processes are evoked and under what conditions they are terminated (Toda, 1964). The problem of screening information has been relatively neglected in discussions of the predecisional processes. One of the decision maker's immediate requirements is to identify, by means of the discrimination process, which items of available information are integral to the problem and which are to be rejected. Certain exploratory responses (Berlyne, 1964, 1965) can facilitate the filtering processes in their information rejection function. These filtering processes are, however, a function of conceptual level and environmental characteristics. Research has consistently shown that the quality of information processing decreases as the information load or environmental complexity increases beyond an optimal level (Schroder, Driver, & Streufert, in press). Higher information loads place greater demands on the filtering, integrating, and evaluating processes which are evoked for purposes of information reduction. According to Posner (1964), the level of demands imposed by complex environments is directly related to the difference between stimulus and response information, the difference being taken as the "information reduced" in arriving at a condensed response.

As functions of the interaction between environmental demands and conceptual level, the different strategies, employed in reaching a decision, determine the amount of information required and the nature of the relationship which must exist between relevant units of information. Specifically, informational and cognitive requirements of the different strategies prescribe the characteristics of predecisional search behavior; the way in which the various informational and cognitive requirements interact, however, appears to be a complex function of environmental complexity and stress factors.

Complex decision-making and predecisional processes

In any real-time situation, the various aspects of complex action unfold at different rates, so that the consequent constraining effects vary progressively. Moreover, the actions available at a given time clearly depend upon the decisions made up to that point. It has been suggested (Koopmans, 1964) that one important way of examining the consequences of a decision is to consider the choice between alternatives with respect to their preserving the flexibility of future selection. In the complex situation, obtaining additional information concerning categories of interest is one kind of action, but "...since information is expensive, the measures required for its acquisition deprive a [decision maker] of degrees of freedom just as effectively as any other resource commitment. One of the problems in training...is in convincing [decision makers] that information is a commodity for which it is worthwhile to sacrifice a certain amount of...operational capability" (Adelson, 1961, p. 728).

The premise of many diagnostic systems, according to Edwards and Phillips (1964), is that when information is inadequate, quantity must to some extent substitute for quality. In such systems, the problem is one of how to use the available information in such a way that quantity does not substitute for quality.

The potential of integratively complex conceptual structures, in regard to the acquisition of necessary information and its utilization, seems significant. Edwards and Phillips suggest that more than the necessary amount of information is usually acquired; without specifically denying that information is acquired in order to reduce uncertainty, they suggest that oversearch derives from the fact that decision makers cannot extract, from the information available, as much certainty as, in principle, the information justifies. This suboptimal information processing behavior would appear to be a function of conceptual structure, the optimality increasing with increasing integrative complexity.

Shepard has proposed (1964) that the optimal decision (based on some given set of alternatives) is the one which leads to the highest subjective evaluation of its ensuing consequences. The notion here is that the limitations of analytical abilities prevent the decision maker from taking proper account, simultaneously, of the various component attributes of the alternatives and from assessing accurately the consequences of the decision. Alternatively, a complete knowledge of the exact nature of the decision situation would permit the development of strictly optimal strategies; constraints which act upon the decision maker, however, permit only what Shuford (1964b) has termed a "constrained optimality" of decisions. Again, as in the case of information processing, the utilization of integratively complex conceptual structures would theoretically improve the optimality of emergent decisions in complex situations. There are a variety of studies (Miller, 1956), however, which indicate that there are severe limitations on the number of conceptual units that can be processed at any one time. Conceptual integrative complexity at least enables the decision maker to structure and evaluate emergent alternatives according to a number of different frames of reference, thus enabling a decision to be made with respect

to an ordering of alternatives in which one ranking indicates a clear advantage in comparison with the others.

As Shuford has indicated, the possibility that decision makers may follow constrained optimal strategies suggests that restraint be used in referring to the nonoptimality or irrationality (viz. Back, 1961) of decisions. Evaluation, by researchers, of human performance in decision-making has been limited by a scarcity of generally accepted objective criteria. The necessity for objective criteria has been most frequently apparent in situations where the decisions must be based on probabilistic information. In research conducted by the Decision Sciences Laboratory (Rath & Allman, 1964), Bayesian formulations appear to be promising as a source against which to assess the performance in such situations. A Bayesian model is used to determine the point, given a particular sequence of informational input, at which the decision maker should have made his decision. As methods of assessing decision-making are further developed, the more meaningful assessments of emergent decisions will provide, simultaneously, the means for directly evaluating the effectiveness of the various decision processes, which are characteristic of different group compositions. As recent research (Dalkey & Helmer, 1963) has indicated, however, effective group decision-making may also be possible in the absence of a direct confrontation of component members and the resultant group processes.

SUMMARY

Decision-making in small groups, varying in composition along a dimension of conceptual level, was investigated from the standpoint of the emergent functional role structure, conflict generation, utilization of conflict in decision synthesis, and information acquisition. The study was directed toward an understanding of the relationship between the conceptual level dimension (the independent variable) and the dependent variables of group information processing structure and specific predecisional processes.

Individuals located at different positions on the conceptual level dimension exhibit different specific information processing behaviors. Since these specific behaviors are closely related to the traditional phases of decision-making (problem perception, information search, generation of alternatives, hypothesizing of consequences, and selection of alternatives), the specific predecisional processes were described as constituting these behaviors. If the phases are considered as functional roles, then the process of decision-making can be viewed as an integration of specific roles. The variable, group information processing structure, was defined as the degree of interlocking of functional roles in the group decision-making mechanism. The metric applied to group structure was the information measure H, which was based on the frequencies with which the different functional roles were assumed by the individual group members. A low value of H for a group would be obtained when the members tend to organize into a rigid structure of separable roles. Conversely, a high value of H for a group would be found when the members tend to exhibit "flexibility" by assuming different roles at different times.

On the basis of the conceptual systems theory, the following hypotheses were advanced:

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information were linearly related, while interpersonal conflict was curvilinearly related, to an increasing PMHCL in the group. The observations indicated that the concept of a continuous dimension of increasing PMHCL, as a prediction variable for specific group decision processes, was tenable. The underlying concept of uncertainty reduction was concluded to be applicable to group structuring, conflict generation, information evaluation, and information search.

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APPENDIX

OBSERVER'S MANUAL

TACTICAL ENVIRONMENT

Princeton University

Summer 1965

This manual is intended to facilitate and standardize the observation of task-oriented groups. The observations are directed toward the decision-making process and the functional role structure as it evolves within the participant groups.

In the simulated tactical environment, the performance of the group depends upon the acquisition of information about the environment, the making of decisions on the basis of the acquired information, and the taking of some action. The observation of the group behavior will consist of coding or categorizing the various decision phases or processes, according to a standard category system. The description of the matrices to be used in the categorization assumes that the observer is familiar with the task environment of the group.

Decision-Role Matrix

The decision-role matrix is intended to provide a description of the decision-making process in the group as a function of individual members' participation. In the matrix, each group member is assigned seven rows -- the seven rows representing the seven possible categories of behavior which are to be noted for the decision participants. The categories of behavior, described below in the sequence in which they usually occur in the decision process, should be thoroughly understood and memorized. The observer should achieve a high degree of facility in coding, in applying the correct category to an individual's overt behavior. The categories do not represent an exhaustive categorization of all the verbal behavior which is likely to occur. In coding contributions to the decision process, the scoring must be in response to changes from one category to another, rather than to intermittent contributions within the same category.

Proposes or structures the problem (A) A member indicates the existence of a problem to be resolved. The problem may be stated assertively or interrogatively; the group member may state that there is a conflict or problem to consider and resolve, may describe the nature of the problem, or may ask for solutions in a particular problem area. This category essentially represents the member's realization or perception of conflict, of the need for some fundamental action, or of the necessity for change in strategy, and his directing of the groups attention to its existence. The category also includes the member's instigation of some action or the setting up of a mechanism on which other actions depend.

Requests information from the group or suggests information search type action (B) A member asks for information concerning the group problem from the group as a whole or from an individual member. This category includes the requesting of clarifying information, the asking of a member for the basis of suggested actions, and the member's suggestion for information search actions by which information could be obtained from the environment. This category represents the member's attempt to acquire information for himself or for the group when additional information is required in the decision-making process.

Supplies information (C) A member provides an item of information to be used in making a group decision. This category includes the factual statements which are given on request or voluntarily, the interpretation of an informational input, and the descriptions of the current state of affairs.

Generates alternatives or suggestions (D) A member proposes possible alternatives to the problem being considered or makes a restatement or modification of an alternative originally proposed by another member. This category represents the generation of various ways of looking at a situation characterized by conflict or need for change and of alternative actions which would resolve conflict or result in change.

Evaluates alternatives and information (E) A member poses counterarguments to given alternatives, elaborates upon given alternatives, or evaluates information, including the current state of affairs, as a preliminary to proposing his own alternative. In context, the stating of a counterargument usually implies a negative evaluation of an alternative; on the other hand, the basis for a positive evaluation may, in some instances, be the member's agreement with another member's conceptual reasoning as it led to the given alternative; overt agreement with the preliminary reasoning is included in the category.

Makes final decision (autocratic type) (F) A member, having apparently considered the information provided by himself or the other members, states what action will be taken. This category includes the decision which is based on the member's own interpretation of available information in the absence of an overt attempt to elicit opinions from other members or to seek a consensus. This type of decision frequently occurs in the presence of persistent attempts to have an alternative accepted or, in some instances, rejected. In some groups, the autocratic type of decision will be made but another decision, concerning the same problem, will again be made at a later point in time; in such cases, the original coding is not changed.

Confirms group decision (democratic type) (G) A member confirms the decision of the group by acknowledging and integrating the opinions contributed by different individual members. There is an attempt to ensure that a member's viewpoint is considered and correctly interpreted. The decision reflects a group consensus which is summarized and restated to the group. The category includes a member's seeking of other members' opinions concerning his own proposed alternative and their readiness to accept it as a group decision.

Observer-Rating Scales

The observer-rating scales are intended to describe the nature of the functional processes which characterize the various styles of decision-making in the groups. Ratings concern both individual and group processes.

Definitions of Scale Terms

Synergistic - behavior marked by verbal attempts to elicit another member's viewpoint, to clarify another's thinking for the group, to obtain all possible information for oneself and the group in coming to understand why an individual has offered specific alternatives; behavior involves frequent checking of interpretations or reciprocal processing of information in order to achieve a consensus of opinion between two or more individuals.

Independent - behavior marked by the rejection or ignoring of proposed alternatives in the presentation of one's own suggestions and autocratic statements, of action to be taken, persistently given in the context of numerous counterarguments.

Empathic - behavior includes statements of considerations which are indicative of the member's putting himself in the place of the enemy, adopting the enemy's point of view; responses are frequently considerations of what action is most probable on the part of the enemy, knowing how the group would respond to the alternatives attributed to the enemy, and, therefore, considerations of the long range goals of both sides.

Retaliatory - behavior is marked by retaliatory, unrelated action decisions and the failure to take into account the position and strength of the enemy; responses consist of statements concerning the effects of one's own action on the other's action.

Conceptually connected - behavior is marked by the drawing of conclusions from a presentation of relationships between facts; inferences are based upon presented linkages between established and hypothetical information, upon presented logical and sequential assumptions or facts, or upon an integration of informational feedback from diverse sources across time.

Retaliatory - behavior is marked by responses indicative of retaliatory, unrelated action decisions, statements of the effects of other's actions on one's own action, and the failure to take into account the position and strength of one's own forces.

Effect of conflict - the extent to which the group either utilizes generated conflict by analyzing and integrating diverse points of view in the synthesis of an emergent decision or suppresses conflict by ignoring or rejecting, with little evaluation, conflicting alternatives or units of information.

Degree of conflict - the extent to which conflict is generated through the proposing and accepting, for purposes of evaluation, of diverse and conflicting alternatives.

Communication within group - concerns the organization of the communication pattern in the group, the extent to which channels are available to various members for transmission of factual and evaluative information; communication concerns the extent to which a group member can transmit and receive diverse kinds of information through the channels linking him to the other members.

Group structure - concerns the way in which group members relate to one another, the extent to which the individual members are integrated in the processing of information and synthesizing of decisions. Group structure is assessed according to the extent of centralization of decision and evaluation (hierarchy), of independent processing with no attempt at synthesis or coordination (independents), of formation of subgroups (factions), of awareness of other's viewpoint without active elicitation (individuals holding together), or of synergistic and integrated processing of information (single organism), in the group. The assessment of group structure involves a consideration of the group communication pattern; a group characterized as a single organism, for example, would manifest an open communication system by means of which information could be processed in a unified or integrated manner.

DECISION-ROLE MATRIX

GROUP NO. _____

DATE _____

C_1	Proposes																					
	Requests																					
	Supplies																					
	Suggests																					
	Evaluates																					
	Decides																					
	Confirms																					
C_2	Proposes																					
	Requests																					
	Supplies																					
	Suggests																					
	Evaluates																					
	Decides																					
	Confirms																					
C_3	Proposes																					
	Requests																					
	Supplies																					
	Suggests																					
	Evaluates																					
	Decides																					
	Confirms																					
C_4	Proposes																					
	Requests																					
	Supplies																					
	Suggests																					
	Evaluates																					
	Decides																					
	Confirms																					

OBSERVER RATING SCALES

Period _____

Group No. _____

Observer _____

The first three scales apply to individual group members. Place the commanders' numbers at the appropriate point on the scale.

1. Individual's functioning within group.

Synergistic						Independent
_____	_____	_____	_____	_____	_____	_____

2. Tactical responses with respect to the enemy.

Empathic						Retaliatory
_____	_____	_____	_____	_____	_____	_____

3. Complexity of tactical response with respect to own forces.

Conceptually connected						Retaliatory
_____	_____	_____	_____	_____	_____	_____

4. Effect of conflict (substantive).

Members utilize conflict						Members suppress conflict
_____	_____	_____	_____	_____	_____	_____

5. Degree of conflict (interpersonal).

Interpersonal conflict manifested						Interpersonal conflict not apparent
_____	_____	_____	_____	_____	_____	_____

6. Communication within group.

Communication restricted to specific channels						Communication is multi-channeled or multi-directional
_____	_____	_____	_____	_____	_____	_____

7. Group structure.

Hierarchy	Independents	Factions	Individuals holding together	Single Organism

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13 ABSTRACT Decision-making in small groups, varying in composition along a dimension of conceptual level, was investigated from the standpoint of the emergent functional role structure, conflict generation, utilization of conflict in decision synthesis, and information acqusition. The study was directed toward an understanding of the relationship between the conceptual level dimension (the independent variable) and the dependent variables of group information processing structure and specific predecisional processes.

On the basis of the conceptual systems theory, the following hypotheses were advanced: (a) structuring decreases or, conversely, role flexibility increases, as the percentage of members of a high conceptual level in the group increases; (b) groups, in which the members are all of a high conceptual level, manifest more interpersonal conflict than groups in which the members differ in conceptual; (c) the extent to which generated conflict is utilized in decision synthesis increases with an increasing PMHCL in the group; (d) the extent of search for novel information increases as the PMHCL in the group increases, whereas total information search is not dependent upon group composition.

Each of the hypotheses advanced was confirmed by the obtained results.

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