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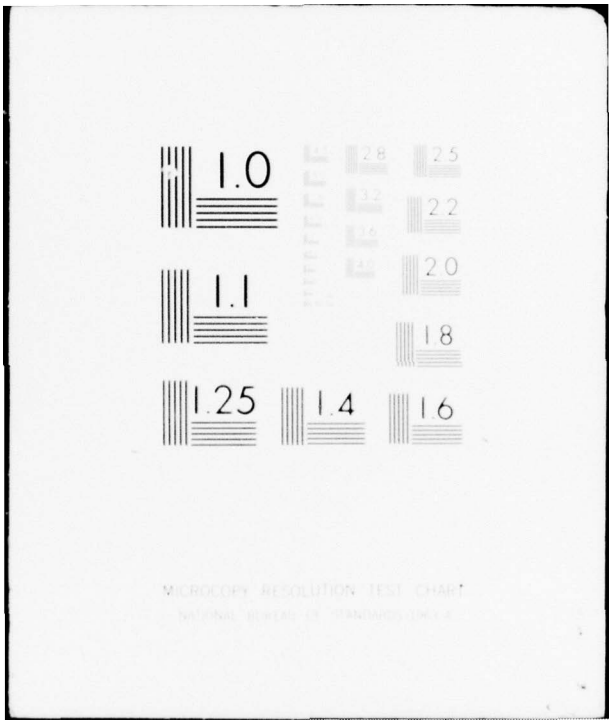
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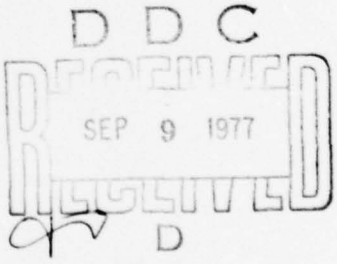
A STUDY OF POTENTIAL CONTRIBUTIONS OF SMALL GROUP BEHAVIOR RESEARCH TO TEAM TRAINING TECHNOLOGY DEVELOPMENT

John J. Collins

ESSEX

201 North Fairfax Street
Alexandria, Virginia 22314

31 August 1977



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A review of the small group behavior research literature revealed numerous potential contributions to team training technology development. Theories, methods and techniques, and findings on substantive variables in group interaction, group performance and productivity, group growth and development, and group motives and goals are emphasized. Research program recommendations are presented. An annotated bibliography is included.

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1.0 INTRODUCTION

1.1 Purpose of Research

The primary purpose of this research was to review the small group behavior literature to identify scientific and technical advances potentially applicable to the development of an improved team training technology. Selected theories, methods and techniques, and substantive findings were examined in an effort to illuminate relationships among the theoretical and empirical foundations of the disciplines and technologies involved, to identify possible unifying concepts related to the development of team training strategies, and to suggest fruitful areas of research.

1.2 Statement of the Problem

Team training is generally recognized by the Department of Defense as an essential and costly program for maintaining military and personnel readiness. Historically the need to improve team training through team training research and technology development has not been given a high priority in comparison with individual training (Defense Science Board, 1976). In part, this lack of support is based on earlier research findings which lead to principles which influenced team training such as: (1) training in individual task proficiency is the foundation for the effective team, (2) limiting the amount of team member interaction results in better performance, and (3) early training in coordination interferes with individual skill attainment (Briggs and Johnston, 1967; Klaus and

Glaser, 1970; Horrocks et al., 1960, 1961). As is indicated in the studies described below, these research findings are not unequivocal, nevertheless they have served to limit the development of a team versus individual training technology. Team training technology is defined in this study as the body of knowledge (theories, methods and techniques, and substantive findings) involved in the design and implementation of training system activities such as: (1) defining team training requirements (duties and tasks requiring instruction, degree of proficiency required, number of personnel to be trained in what period of time), (2) development of objectives and achievement tests (identification of behaviors, criterion and enabling objectives, and entering behavior and criterion tests), (3) planning, developing and validating instruction (sequencing of learning activities, selection of media, identification of resources requirements), (4) conduct and evaluation of instruction, and (5) operational evaluation of the training system (team performance, cost-effectiveness). Team training technology is conceptualized as focusing on the team as a functioning unit and the performance of that unit rather than just the performance of individual team members.

The following reflect new and recent concerns in the Department of Defense and the Department of the Navy about both operational and technical requirements in team training and team performance.

The Chief of Naval Education and Training sponsored a comprehensive review of operational team training programs and technical deficiences in team training technology (Hall and Rizzo, 1975). The findings and recommendations of the

resulting report emphasize needed improvements in:

1. developing objectives for team training.
2. composing a training environment.
3. conducting training exercises.
4. applying a systems approach to team training.
5. applying current research knowledge to practical training situations.
6. identifying (1) critical performance variables in team tasks, (2) variables and situations which determine legitimacy of a "team" and (3) decision rules for determining when or where a team approach rather than only an individual approach is appropriate.

From their review of the technical literature, Hall and Rizzo conclude that "technically, the question of whether individuals functioning in a team setting require unique skills which can only be developed through training in a team context remains unsolved." These authors also state (p.34): "Of particular interest are the underlying social aspects of team behavior which seem to affect performance. The manifestation of "team awareness," adaptive, as well as creative behavior, seems to be crucial to effective team performance."

The Department of Defense Science Board Task Force study on Training Technology addressed a variety of training requirements, including team training, and training research and development planning and utilization of results. Specifically, the following issues enumerated were: (1) procedures to establish Training Technology R&D requirements and priorities within OSD and the Military Departments, (2) technical, administrative and managerial capability to

provide responsive Training Technology R&D programs that address critical DoD training and education problems with maximum efficiency for minimum costs, and (3) approaches to expedite application and implementation of Training Technology R&D output (Defense Science Board, 1976).

Some of the unresolved problems from the report identified as requiring increased support by both the operational and research communities are:

1. better assessment methods for costing and training effectiveness.
2. close coordination and cooperation of training technology R&D and both training and operational user commands and working units.
3. insufficient attention is now being given to the training of crews, groups, teams and units. This is an area in which significant improvements in efficiency and effectiveness are now possible.
4. insufficient assessment (test and evaluation) of advanced training methods and of prototype training equipment and simulators.
5. some question exists regarding the degree to which SAT (Systems Approach to Training) (or ISD) is being correctly implemented, and there is little or no evidence of its actually producing cost-effective results.

From the detailed examination of CGTU (Crew, Group, Team and Unit) training, the report contains comments and recommendations as follows:

1. Scope of CGTU Training - The circumstances of embeddedness (in the operating forces) make it difficult to identify, for purposes of this study, what the Services do recognize as CGTU Training, or to obtain corollary data on student loads and training costs (p.36).

2. CGTU Training R&D - Despite the magnitude of CGTU Training in the Services, there is very little R&D on CGTU Training at the present time. Also there are marked differences among the Services with regard to stated requirements for CGTU Training R&D. The Army (TRADOC) is currently emphasizing the need for and importance of Training Technology R&D in this area (p.36).

3. Hardware Technology Advances - Relatively recent advances in hardware, such as the laser, the digital data-processing system, and large-scale integration (LSI) of digital circuits, constitute potentials for improving some types of CGTU Training (p.36).

4. Range of CGTU Training R&D Requirements - A wide range exists from (a) routine but important servicing of user needs and R&D on training-system variables, to (b) the generation and nurturing of bright ideas that may offer substantial improvements in performance and/or reductions in cost (p.37).

5. Recommendations - Initiate systematic R&D to develop a taxonomy of operational force elements (crews, groups, teams, and units), and on methods for controlling training variables in the context of process-control models. This R&D should have first priority to establish a framework for subsequent, programmatic R&D on CGTU Training (p.37).

During this same time period, the Defense Advanced Research Projects Agency sponsored a state-of-the-art review of selected team training and evaluation strategies, the purpose of which was "to provide information to the Defense Advanced Research Projects Agency which would be useful for planning research and development programs in the area of team training" (Wagner et al., 1976). In suggesting a research program in response to this requirement, Wagner et al. state: "the major factor in this program is the need

for methods which differentiate individual, multi-individual, and team skills and training requirements....Possible techniques to study for this purpose are variations of interaction analyses and other unobtrusive measures" (p.4).

In summary, it is clear from these studies above that improvements in team training are needed to meet urgent operational and administrative requirements. On the technical level, little progress is reported during the past several years in part due to a lack of research and development support, and in part due to the limitation of research strategies historically employed. Fundamental unresolved issues cited in the literature, as well as being voiced by operational training personnel, relate to:

1. the definition of a team in meaningful operational and training terms.
2. distinctions between teams and small groups.
3. identification and development of team training objectives and technologies
4. relationship between team training and team performance.
5. the adequacy of team training system design and implementation methods such as instructional system design.

1.3 Objectives of Research

The rationale for this study takes the form of publicly-expressed military operational requirements for improvements in the state-of-the-art in team training technology, and a preliminary assessment of the potential for resolving some of these problems through the application of theories,

methodologies and substantive findings from small group behavior research. This latter view derives from both changes in directions and advances in small group behavior (Hare, 1976; Steiner, 1972; Hackman and Morris, 1975; Federico, 1976; Zander, 1971). Federico (1976), for example, conducted a literature review to determine the degree to which computer simulation could be used to overcome the myriad of obstacles impeding "the scientific understanding of, and the application of knowledge to, psychological and sociotechnical systems." A general conclusion from Federico's findings is that a large body of knowledge exists in such areas as small group structure, social process modeling, goal setting, social learning, and group performance and measurement. Similarly, Hackman and Morris (1975) identified numerous findings from their review of group interaction and group performance effectiveness research which can be considered for integration with the findings to advance team training technology. Steiner's (1972) and Zander's (1971) contribution in the areas of group productivity and group motives and goals provide other data of potential utility in this regard. The main substance of this report is directed toward the analysis and integration of information from these and other theoretical and empirical developments for the purpose stated above.

Within this context, the primary objectives established for this study were:

1. to review and analyze selected portions of the literature on theoretical and empirical research in team training and small group behavior.

2. to illuminate the relationships among the disciplines and technologies involved at the levels of theory, methods and techniques, and substantive variables.

3. to identify a set of unifying concepts for developing an improved team training technology.

4. to collect, assess and synthesize information on scientific and technological trends and gaps in these two areas.

5. to develop an annotated bibliography of relevant reference materials.

6. to develop recommendations for research to fill the scientific and technical gaps, and for capitalizing on advances supportive of team/crew/group/unit training requirements.

The objective of identifying a set of unifying concepts (objective 3 of the project) was viewed principally as one of searching the literature for concepts, findings and new methodologies for dealing with fundamental issues relating to team definition, team training and team performance. Optimistically one might identify concepts and findings from research on a number of variables which might improve systems of classification and assessment of small group behavior research and facilitate development of generalizations across disciplines. On the other hand only suggestive theoretical formulations and empirical findings might be identified which provide for some integration, or development of researchable or, at varying degrees of confidence and risk, operationally-usable approaches to improving team training and related issues.

2.0 RESEARCH STRATEGY AND METHODS

2.1 Literature Review

The research strategy included first a literature review and compilation of information from two substantive areas, i.e., team training and small group behavior. The planning of the literature search recognized the differing characteristics of the body of scientific and technical information in the two areas. For example, in the area of small group behavior, research investigations and reports have been voluminous over the past twenty-five years. Hare's (1976) revised handbook includes 6037 references compared to less than 1400 in the 1962 first edition. Whereas in the area of team training, there has been very little research conducted and reported on in recent years (Hall and Rizzo, 1975; Meister, 1976; Wagner et al., 1976; Defense Science Board, 1976). Of particular significance has been the absence of theoretical research on team operations, development and performance. In contrast, within the area of small group behavior, Steiner (1972) notes the renewed interest in the group as a productive unit and the shift from attention to processes that occur within the single individual.

These and other contrasting conditions prompted different approaches to the literature review and the collation of results. For the team training area, comprehensive coverage of published research during the past twenty-five years was sought. Summary reviews of work completed prior to 1967 were available and were supplemented by reviews of primary source materials where deemed necessary. For the period subsequent to 1967, the principal references available were

reviewed and reported on.

The review of the literature on small group behavior involved a process of selection based primarily upon: (1) the practical problems of applying project resources in an effective manner to the large amount of published information, and (2) collecting and processing the most relevant information. On the basis of these two considerations, the search focused initially on recent summaries of small group behavior research and the published works of well-known researchers (e.g., Hare, Steiner, Hackman and Morris, Zander, etc.), and on primary references collected from systematic searches of automatic information systems, library sources, recent bibliographies, etc. These searches included sources such as the Defense Documentation Center, Naval Research and Development Information Center, Smithsonian Information Exchange, National Technical Information Service, Psychological Abstracts Search and Retrieval, Sociological Abstracts, Advances in Experimental Social Psychology, Annual Reviews of Psychology, and numerous professional national and international journals. The results of these searches are contained in the reference list and annotated bibliography.

Many references reviewed are not included in the list because of their lack of relevance. This situation reflects the difficulties involved in searching large numbers of reports which were apparently pertinent by title but on review were found not to contribute sufficiently to existing knowledge to warrant their inclusion. This experience is consistent with that of other researchers (Wagner et al. 1976, p.12). The results of this search strategy are a combination of primary and secondary references from which a body of

information on theories, methods and techniques, and substantive variables of potential interest was reviewed.

2.2 Analysis and Synthesis of Data

The organizing framework for the analysis and synthesis of data centered on two elements of the systems analysis of training (SAT) approach to training system design. These elements were the development of training requirements/objectives and operational evaluation of training systems. These two areas were selected as priority areas related to previously-described, fundamental issues of team training system design, i.e., team training definition, training objectives, and team performance. Other areas of the SAT training system design approach such as selection test development, course design, instructional media selection, achievement test development, and validation of instruction were not included. Table 1 describes the structure and elements of the instructional delivery system process.

Selection of these two SAT elements provided a focus with which to search and to synthesize the information collected. The preliminary search included a large number of substantive areas which, after review and analysis, were reduced to those providing theoretical and empirical insights into the training and performance issues of concern. Small group behavior research areas selected for primary attention emphasized small group development and group productivity (performance). The logic of this approach relates to consideration associated with the development of Navy teams of first term enlisted personnel. Briefly, the enlisted Navy first term population is largely 17-19 year olds, 69-70% of whom attend formal schooling to qualify for entry into a particular occupational speciality (rating), attend additional schooling to develop more equipment or systems-oriented skills, are assigned to fleet or shore

TABLE 1 - INSTRUCTIONAL SYSTEM DEVELOPMENT STRUCTURE

Define E&T Requirements	Develop Objectives and Tests	Plan, Develop & Validate Instruction	Conduct & Evaluate Instruction	Operational Evaluation of the Instructional System
1. duties & tasks requiring instruction	1. identification of behaviors (knowledges, skills, attitudes) required for successful performance	1. planning of instruction to satisfy learning objectives	1. improvement & redesign an integral part of process	1. operational and administrative criteria for evaluations
2. degree of proficiency to be developed	2. a. criterion objectives: end-behaviors and conditions under which they are to be demonstrated	a. sequencing of learning activities or exercises to achieve results in shortest time	2. student attainment or non-attainment the primary method of evaluation	
3. number of personnel to be qualified	b. enabling objectives: 1. prerequisite knowledge & skills essential to attainment of criterion objectives	b. selection of methods, media, & equipment which most effectively supports learning objectives	3. meeting requirements of operating commands; i.e., man can do what he is taught to do.	
4. time required to develop instruction	2. criterion tests to measure student achievement and effectiveness of instructional systems; also entering behavior measurement	2. identify resource requirements: a. development and validation of instructional materials		
5. criticality & learning difficulty of tasks		3. validation to insure all elements are functioning effectively		
6. availability & qualifications of personnel to operate the instructional system				

organizations to be integrated into teams, and during their term of enlistment of 4-6 years, they are assigned to one or perhaps two more organizations receiving more advanced training in schools or in on-the-job training. Implicit in this general pattern are several areas of development including physical, emotional, intellectual, occupational, etc., of particular importance to young men and women in this age group. Study of these various kinds of developments and the ways in which they interact within the military environment has not been reported in the literature, and is beyond the scope of this study. However, this study attempts to examine theoretical and conceptual approaches to small group development which might provide some insights into this process of development and performance and suggestions for fruitful research. The analysis and synthesis of the small group behavior research literature have been approached, therefore, with the objective of determining contributions from theoretical, methodological and substantive findings to the understanding of team training and team performance within a group development framework and in the context of a systems analysis of training approach.

Further discussion of systems approach of training concepts is considered desirable at this point to provide additional perspective on the synthesis of the information collected. Montmerlo and Tennyson (1976) reviewed the historical developments in systems approach to training (SAT) or instructional systems development (ISD), and provided a bibliography of approximately 4000 entries dating from 1951. They report that they find the state-of-the-art to be "unsettled." More than 100 ISD manuals are identified which contain fundamental disagreements on the basic concepts of course design and none of these manuals has been empirically validated.

The authors point out that the original SAT concept based upon systems analysis included three main features: (1) use of an interdisciplinary team of experts to maximize the application of as much relevant information as possible, (2) use of "models" for reducing complex problems to analyzable proportions, and (3) design of a unique method for solving the problem which is as systematic as the problem will allow (p.9). The contrasting approach which developed was based on the hypothesis that experts could develop models of the methods and techniques which reduce the design of training programs to a linear sequence of procedures which can be successfully followed by personnel inexperienced in program design. The generic concept denied that such complex problems could be solved procedurally.

The original SAT concept is receiving renewed interest as a result of recent reassessments and conclusions that "available theory and empirical evidence on the process of learning and teaching do not support the proceduralization of the training program development process" (p.12). However, both approaches are being applied and both require extensive empirical research to identify which approach is more effective and efficient or what synthesis of the two approaches is desirable. The feasibility of developing ISD following the original concept for application to team training rather than its traditional use for individual training is examined in this report.

3.0 THEORETICAL AND METHODOLOGICAL DEVELOPMENTS AND TRENDS

3.1 Team Training Research Trends

The evolution of the technology of team training has been strongly influenced, beginning in the early 1960's, by concepts of systems analysis and military weapon system development approaches (Gagné, 1962; Glaser, 1962; Montemerlo and Tennyson, 1976). As a result, team training and team training research have developed goals, methods of development and investigation, and evaluation criteria distinct from a psychology of learning (Eckstrand, 1964). In addition, because of the demands of the systems approach to training to demonstrate the operational relevance of the training content and the levels of training achievement, team training and team training research should be more closely tied to team performance (Briggs and Johnston, 1967; Meister, 1976). These demands stem from the heavy emphasis on mission, function and task analysis in defining training requirements, and on the operationally-oriented criteria required for evaluating training in school and operational environments. The development of acceptable performance feedback systems for these purposes is yet to be accomplished.

The Defense Science Board recently reported that the cost of training in the Department of Defense approximates $7 billion annually not including training conducted by operational units (Defense Science Board, 1976). On economic grounds alone, a rationale exists for directing

considerable effort toward insuring the efficiency and effectiveness of training. The previously-mentioned systems approach to training is designed to support such an objective, but whether this approach has in fact achieved its objectives has been questioned by the Defense Science Board (1976). Nevertheless it is and will undoubtedly continue to be the principal approach to training program development and evaluation (USAF 1970, 1973; Branson, et al., 1975; Montemerlo and Tennyson, 1976).

During the period of development and implementation of systems approach to training techniques, two trends have negatively influenced the development of team training and team research. One is the emphasis on the study of individual behavior in the DoD Human Resources RDT&E program, resulting in a limited program of team training research and development beginning in the mid-1960's and continuing through at least FY 1977. Recent reviews by Hall and Rizzo (1975), Wagner, et al. (1976), and program searches by this writer as part of this study, document the limited amount of team training research in recent years and in DoD planned programs (Defense Documentation Service, 1976). Wagner, et al. (1976) included 97 references in their review of the state-of-the-art beginning with 1952, of which 11 are technical reports related to team training published between 1970-1976, an average of less than 2 per year. Meister's (1976) citations in his chapter on team functions, including team training, reflect this same condition. The Defense Science Board (1976) report recommendations for increases in the level of resources for development and implementation of new team training technology are directed toward reversing this trend.

Gagné (1962, 1965), assigning secondary importance to traditional learning principles, set forth basic principles of training design in the context of system development. The principal thrust of Gagné's conceptualization was to emphasize what must be learned and what the substantive content of training must be to insure transfer to totaltask performance. Training studies using a systems approach to training purport to be an implementation of these concepts but questions have been raised as to whether SAT has been applied correctly.

With regard to a second trend, team training theory and models development, the field may best be described as characterized by an absence of trends. What one observes are sporadic efforts in theory development within a limited number of highly-specialized conceptual frameworks. Alexander and Cooperband (1965) summarized this research in terms of two categories of theories involving characteristics of task-oriented teams and how they learn - the organismic theories and the S-R theories. Organismic theory emphasizes temporal processes of development growth, and performance is related to level of development. Coping with adaptation to, and manipulation of the environment are viewed as essential for growth. Development of system awareness, an integral model of the environment, and the exploitation of the potential self-organizing or adaptive capability of a team are assumed to underlie the development process. The development and growth concept has been supported by limited amounts of research on stages in the development of cooperative behavior (Jordan, et al., 1963), stages in the development of skill in analyzing errors and in dealing with them (Boguslaw and Porter, 1962), and by the development of rules (principles) of team development (Kennedy, 1962; Chapman

et al., 1959). It should be noted that these are not recent studies and no recent efforts related to these concepts were identified in the literature review on team training.

Research by Glaser and his associates emphasizing the application of principles of operant conditioning to team training is classified in the stimulus-response category (Klaus and Glaser, 1970). In their early studies, Glaser ans his colleagues conducted direct examination of Navy operating teams and found hazy, changing boundaries and functions which led them to focus attention on individual members and their responses within the team. Detailed analysis of team training led these researchers to underscore the importance of the information processing and feedback aspects of team behavior, and the supervisory and monitoring functions in the team (Glanzer, 1962). In a later series of seven studies during 1960-1967, Glaser and his associates studied the team, rather than individual members, and the team product as a whole as the units of investigation, to determine the effects of various conditions of reinforcement. One general conclusion reached was that intact teams can be considered in much the same way as individual learners have been considered in the past. Also, that the performance of a team is predictable from a knowledge of team arrangements and individual member's proficiencies (Klaus and Glaser, 1968). These authors state, "the theoretical implications of this program of research principally reflect the notion that a team can be defined as a group of individuals who all are reinforced by a single event and the notion that the performance of a team can be a suitable module of behavioral investigation. This approach is closely analogous to

that used to study a sequence of responses or "operant chain" as it is called in the learning laboratory" (p.55).

Alexander and Cooperband (1965, p.20) compare the two theoretical models by noting:

1. both models reflect reality but differ in their assumptions regarding behaviors to be trained in order for overall performance to improve.
2. the S-R model applies to teams operating in established situations, i.e., almost completely specified tasks, rigid with regard to organization of tasks and assignment of functions among members, and limited coordination requirements within a highly-determined series of responses.
3. the organismic model is oriented toward teams primarily in emergent situations involving a high degree of discretionality for performing tasks under various environmental conditions; proficient team performance depends upon cognitive organization of the environment and idiosyncratic team procedures; coordination involving development and modification of plans which integrate operating procedures; requires adaptive innovations.
4. there is essential agreement on which variables are likely to affect team performance improvement but different emphasis placed on each because of different initial assumptions regarding behaviors to be trained and the products of training.

Alexander and Cooperband (1965, p.37) present their view of a team, which reflects their preferences regarding theoretical positions, as follows:

> "The team is an information processing system which has a large storage capacity, part of which is devoted to procedures for action that are organized hierarchically into plans which coordinate the behavior of the individual members. These plans may be given to the

team (e.g., by the system designer) or they may be generated by the team itself based on previous experience with the environment. The task situation determines which plan(s) will be utilized. The performance of the team depends on how good the plans are and how well they are executed. As a result of continuing experience with the environment, the team generates and tests new plans and adopts some of them. The rate of generation, testing, and adopting new plans, the quality of new plans, and the level of skill in executing them may be modified by manipulating the experience of the team and will be reflected as a change in team performance. This entire process may be considered as a two-level learning process: learning the characteristics of the environment, and learning new methods for responding to it. To the extent that what is learned at either of these levels can be transferred to new and indeterminate situations, team performance will improve."

Wagner et al. (1976) reviewed the training research literature and classified available research investigations in terms of emergent and established situations. Boguslaw and Porter (1962) previously introduced this concept in an effort to draw attention to the situational context in which teams exist. They suggested a continuum which extends from a high degree of specificity about "environment" states and conditions, and the adequacy of research technology for predicting consequences of alternative actions to unspecified states and low predictability. Laboratory investigations are viewed as falling within the established category and field research within the emergent category. Wagner et al. (1976) used a second dimension, team versus multi-individual, to provide a 2x2 matrix for classifying the team training research reviewed. The matrix was used to classify studies which included consideration of individual versus team training, team skills, simulation fidelity, feedback/ knowledge of results, team structure and composition. Some

of the trends identifiable from this classification scheme are: (a) most of the studies and classified team/established (laboratory) category, (b) feedback and knowledge of results studies of teams/established are largest in number, (c) no studies of team skills in the team/established category are reported, (d) few studies in simulation fidelity are reported for either team or multi-individual category, and (e) most of the studies of team structure/composition are classified in the team/established category. Wagner et al. (1976, p.3) point out that the investigations which attended to the emergent factors in the job situation had demonstrated the need for training in team skills, even though individual skill proficiency was found to be a prerequisite for effective team training and performance. These authors also note that a major factor underlying their research program recommendations is the need for methods which differentiate individual, multi-individual and team skills and training requirements (p.4). This factor points out again to the absence of trends in team training research to resolve this fundamental issue.

Campbell (1971) reviewed the research literature in personnel and training development, including attitude theory, motivation theory, behavior modification, individual differences, general systems theory, new developments in technique, evaluation methodology, and empirical research. Finding his literature review "disheartening," Campbell cites two principal reasons for the failure of training and development to realize its potential. The first reason is that there has been a broad and full scale retreat from the fundamental task of defining what is to be learned, and the second reason is that there are few incentives available for simulating the effort necessary to develop sound

theoretical models, build a technology of assessing what is to be learned, and accumulate a broad data base (p.594).

Cooperman and Asa-Dorian (1976) described methodological research in anti-submarine warfare training in which a large team trainer is used. The first three phases of the training is ashore at the training center and the fourth phase is at sea. Two commonly-recognized problems cited by the authors are the lack of specific training objectives that can be readily converted into measurable performance criteria and the use of instructor's subjective measures of adequacy of performance in training. This situation is not unique to this particular team trainer. Other problems often mentioned in the training device literature include: (1) failure to use state-of-the-art training technology in design or use, (2) absence of training instructions, (3) overemphasis on training procedures, (4) training teams are "scrub" teams, and (5) trainees often lack the requisite skills. These difficulties combine in various ways to limit the effectiveness of team training, the use of team trainers, and the development of team training technology. The research reported by Cooperman and Asa-Dorian involve development of a graphical representation of training problem events, and a listing of numerical information associated with critical occurrences. Performance of subteams can be determined from the plot developed. Future effort will include development of a variety of computer-based problem (graded) scenarios which will provide a training option that should increase training problem standardization by placing target maneuvers under computer control. These new capabilities are oriented toward improvements in team training requirements, team instruction, and team evaluation.

Two related efforts are Project NORM (Birkett et al., 1968; Zagorski, 1973) and the research of Obermayer et al. (1972). Project NORM objectives included determining how situational variables as measures of exercise difficulty affect SAGE crew performance. Results of an exploratory study indicated that situational variables can be selected as measures of exercise difficulty by linear multivariate regression analysis using performance variables as criteria, factor analysis can identify the best measures of crew performance, expected scores on the selected performance variables can be described from various combinations of the selected situational variables, and actual crew performance scores can then be compared with expected scores. A subsequent study included a field test and demonstrated how different combinations and weights of 13 situational variables predicted each of 8 performance indices. Chesler (1970) discusses the utility of the NORM approach in studying Navy anti-air warfare team training, noting that automated performance evaluation does not resolve the criterion dilemma, nor problems of methodology and rationale for analysis of individual and group behavior. A unique concept which Project NORM does possess is relative performance evaluation which takes into account environmental characteristics and situations in which performance is being measured. As Zagorski (1973, p.5) writes: "The relative performance concept is the key aspect of NORM as it indicates the performance level in terms of potential capability determined by critical analysis of the situational variables operating within the environment."

Obermayer et al. (1972) report on a study to improve the acquisition of aviation combat-crew training performance through the systematic definition of performance measures appropriate to combat training needs, and the definition of

a cost-effective measurement system usable in combat-crew training environments to acquire and process needed training information. The strategy employed in the design of the measurement system emphasized use of data identified as meaningful by training management and instructor personnel. In studying the requirements of six aircraft consolidated into a common framework of maneuvers, more than one hundred measurement parameters for combat-crew training were identified which gives evidence of the magnitude and difficulties in developing meaningful, operational personnel performance measures. In investigating crew interactions through communications measurement, it was stated, "The combat airlift mission in the C-130 and C-141 aircraft involves such close coordination of pilots, navigators, loadmasters and engineers that it is difficult to isolate an individual's performance (even the crewmembers themselves cannot be sure of the adequacy of their performance)" (Obermayer et al. 1972, p.29). The performance measures and performance measurement system developed represent methodological advances but further development and application of this system for aviation training has not been reported.

In summary, trends in the team training technology point to serious problems of underdevelopment (Hall and Rizzo, 1975; Wagner et al., 1976). Some specific capabilities required and lacking programmatic support are: (1) task analysis methodology for various classes of team training, (2) definition of and development techniques for team training objectives, (3) techniques for determining training content for both shore-based and shipboard on-the-job training, (4) objective situation-specific measures of team training achievement and effectiveness and (5) team

performance standards and measures for feedback and other uses. These improvements directly support developing an improved training technology which for the most part must include consideration of complementary classroom, simulator and underway training in some cases. What is especially obvious is the absences of any trends in the development of team training models for different kinds of team training. Failure to use available educational and training technology, as well as to resolve fundamental issues relating to team concepts and team performance, has relegated team training to a questionable state of effectiveness. Without a renewal of priorities and programming of resources, only the most meager changes to this trend can be expected.

3.2 Small Group Behavior Research Trends

A review of the history and present state of small group research was published recently (Hare, 1976). One of the more important general trends noted is the accelerated rate of publications which has now reached a level of approximately 200 articles a year. Several small group researchers have expressed concern about the impossible task of classifying and integrating the large quantity of theoretical and empirical research and developing maningful generalization (Insko and Schopler, 1972; Helmreich et al., 1973; Hare, 1976). Similar concerns have been expressed about qualitative deficiencies in the research, particularly the absence of new theoretical formulations (Borgatta, 1960; Hackman and Morris, 1975; Helmreich et al., 1973). Steiner (1964, p.440) concluded from his review of group dynamics that the volume and methodological

sophistication of research have increased but there were no striking changes of conceptual orientation. Further, he notes the historical development from armchair speculation to very restrained and cautious theorizing to a new period of theory and experimentation as partners.

Scientific and technical developments in small group research parallel that of psychology, particularly social psychology, and certain areas of sociology (Hare, 1976). During formative years, researchers found little agreement on the most fundamental issues, e.g., the environmentalist-behaviorists versus the innate-inborn adherents (McGrath and Altman, 1966). During the period 1898-1905, most of the central ideas and methods in small group research appeared. One area of emphasis was whether the group makes any difference for the individual working on problem solving tasks and what kinds of problems are best solved by individuals and groups. A second area of emphasis was whether individual activity was significant in the face of group pressure to conform to norms. Between 1905 and 1920, comparatively little research was conducted. The period 1920 through the 1930's was one of rapid growth with emphasis on "together and apart" studies and the facilitating effect of co-workers on an individual's performance. Most of the contemporary concerns of small group research began to appear in the period 1930-1940, e.g., sociometric investigations, group work, social integration, and group dynamics. From the mid-1930's to the early 1960's, three main schools of small group research dominated the field - sociometry (Moreno), group dynamics (Lewin), and small groups (Bales) (Hare, 1976). The recent period has seen the continued dominance by psychologists, followed by sociologists and

then by professionals in psychotherapy, education, social work and business.

Currently psychologists' major technical emphasis is on cognitive balance in social relationships, bargaining, and risk taking. Sociologists emphasize a model of behavior drawn from economics in which "actors" are seen as making exchanges to maximize their social profits at the lowest social cost. Most of this research focuses on the actor not the group. Social psychologists have been studying the relationship between personality variables (mainly authoritarianism) and conformity (mainly in the experimental situation similar to that used by Sherif in 1935 and Asch in 1951. Recently, about one-third of the experimental studies of small groups have been directly related to conformity. Relatively few of the experimenters have worked within a general theoretical context which would allow them systematically to relate their results to the results of others (Hare, 1976). The next largest area of research includes the sociometric studies of interpersonal choice. In some cases those studies are related to the area of social perception involving perceptions about others liking for them or others in the group, perception of personality traits, or other social characteristics. Social perception ranks below interpersonal attraction and about on a level with studies of interaction process in popularity as a research topic. Leadership represents about 10% of the total output for the years 1959-1969. Research topics which are receiving the most attention are quite similar to those which have historically attracted support: conformity, interpersonal choice, social perception, interaction process and leadership (Hare, 1976). Areas receiving little attention since 1962 include roles, personality, social characteristics, group size and various aspects of group produc-

tivity. Some topics which can be approached by simulation, gaming or simple laboratory experiments, e.g., the helping response, competition and cooperation in games, trust and threat in games, the risky-shift phenomenon, and use of personal space, have been receiving more attention than the older established areas.

Steiner (1972) provided a perspective on the history of the study of group productivity. He described the earliest research as regarding the group as a setting in which individual behaviors might be influenced by subtle social processes with no attention to pooling individual resources to produce a product. Just prior to World War II, the focus was on demonstrating the superiority of group action over individual action with diverse findings due to a large extent to the emphasis on productivity and neglect of task demands and process. After World War II, the emphasis shifted to process and ignored productivity. Steiner (1972 , p.10) cites the research using interaction process analysis (Bales, 1950) and the "group dynamics movement" (Lewin, 1951) as examples. This post war shift also involved discarding the "ad hoc" group and shifting to "synthetic" groups which turned out to be equally unproductive as a research strategy. Steiner notes (1972, p.12) the increasing interest in attempts to analyze task demands and the efforts of some researchers to conduct group productivity research using strategies more effective than those contained in the general trends described above.

Theoretical research in small group behavior is roughly divided into two areas: experimental (group productivity, risky shift, etc.), and the experiential (effectiveness of T-group training, interpersonal trust in groups,

etc.). In the experimental areas much of the stimulus for theory building stemmed from the work of Lewin's field theory, Bales' interaction theory, systems theory, Moreno's work in sociometric relationships (Cooper, 1975). Much of this stimulus took the form of insightful observation and speculations but could not be considered comprehensive theories. Since the 1950's, efforts to objectively evaluate phenomena earlier speculated upon have been strongly empirical and devoid of theoretical formulation. It is this large volume of research literature which various researchers have found so difficult to develop a classification system for and from which to identify meaningful generalizations, or to integrate into theoretical formulations except in a limited way.

Cooper (1975) writes that the development of experiential group psychology is similar to the experimental area. In the experiential area much of the speculation stemmed from the works by Argyris, Bion, Bennis and Shepard, Tannenbaum, et al. Again an enormous amount of empirical research has been conducted, much removed from early conceptualizations. Some theoretical work has been pursued (Mann, 1967; Argyris, 1962; Golembrewsi, 1972; Cooper, 1969), but in a narrow and restricted form (Cooper, 1975). The developments in the experiential area have provided some insights into theoretical formulations for effective group learning environments, interpersonal variables (i.e., personal theories of action), individual differences in learning styles as it relates to group processes, and some group process variables (e.g., group support).

Helmreich et al. (1973) published a review of small group behavior research for 1967-1972 "concentrating on

approaches where methodology, theoretical impact, or application seem most promising." The authors repeat the commonly reported concern about the absence of unifying theoretical position on group dynamics, lack of concern with external validity or potential application, the "mundane significance" of the literature over the past ten years, and the impossibility of conducting a comprehensive review of the field.

In the area of methodology, the authors find that most of the innovations center on naturalistic research with attention to systematic observation, objective coding of natural phenomena, and treatment of extensive longitudinal data. The authors note the lack of involvement with statistical techniques for the analysis of multivariate repeated measures, designs and procedures for making causal inferences from such data. Path analysis is cited as one fruitful approach to the search for causal inference from correlation data. Apparently more developments have been taking place in sociology than in psychology (Helmreich et al. 1973, p.338).

The substantive areas covered in the review include attraction, conformity and social influence, cooperation and competition, performance, leadership, encounter groups, and a postscript. In the postscript the authors provide a few predictions about the directions that research will take over the next few years: (1) increased emphasis on studies of processes within groups and on the interactions of multiple situational and individual variables over time, (2) more attention to multivariate, longitudinal research, (3) greater acceptance and testing of cognitive models and cognitive phenomena, and (4) a shift from the laboratory

environment to nonexperimental research involving the systematic study of groups over time (Helmreich et al. 1973, p.350).

The substantive area of primary interest in this article is performance which covers social facilitation, task performance, and the risky shift. The findings are included later in the section on performance.

Gibbard et al. (1974) reviewed methods and techniques employed in the analysis of groups and point out that drawing distinctions between experimental and experiential methodology can portray more polarization than exists and thereby create unnecessary controversy. Continuing, they note that studies in small group field can be arrayed along the statistical-clinical continuum. The work of Bales (1950), with his act-by-act scoring system for group interaction-interaction process analysis, emphasizes the sociological tradition. This system has provided some generalizations about group development, role differentiation and individual differences in a variety of settings. Other similar scoring systems have utilized sign process analysis to study the development of self-analytic classroom groups (Mills, 1964), and to assess the feelings of members in various classroom groups by member-leader and member-member scoring system (Mann, 1966; Mann et al., 1970). These approaches emphasize reductionism and statistical treatment of atomistic events to elicit patterns of group behavior. Weick (1968) provides a review of the literature on the numerous approaches developed for coding interaction in groups, of which the above three are illustrative.

Other methodological approaches cited include the work

of Leary (1957) who postulated two orthogonal bipolar dimensions: the dominance-submission and love-hate dimension. Efforts to develop this concept into a scoring system for groups have not been very productive. Schutz (1958) used an observer rating form and observation system based on the needs for inclusion, control and affection. Thelen (1954), basing his efforts on Bion's theory of group-"basic assumption" activity, developed a system for scoring group interaction. The common objective in these approaches is to code verbal interactions systematically in an effort to identify more nearly universal dimensions of social interaction.

A somewhat different approach within the general statistical category focuses on postmeeting variables which include a larger representation of group members not just the verbally-active members. An example of this approach is that of Dunphy (1964, 1968) who used postmeeting writings of the week's events in two self-analytic groups to study role differentiation and group development. The technology in these studies is a computer-based content-analysis system. A limitation of this approach is failure to take into account the context and connotation of the content being coded.

The clinically-oriented approaches also seek to develop unifying concepts of group behavior but their methodology is global rather than atomistic and impressionistic rather than statistical. Bennis and Shepard (1974) represent this approach, along with Bion's (1959) and Slater's (1966) theories and methodologies. Much of the group therapy literature that is case-study oriented and most psychoanalytic work is in this category. Although

difficulties in operationalizing and quantifying the processes involved exist in the clinically-oriented approach, there is a body of knowledge produced which should not be discarded solely on the basis of the preference for a statistical approach.

Some investigators have attempted to utilize both methods. Bales (1970) combines his interaction process analysis with factor analysis investigations for more in-depth studies of individuals. Mills (1964) also used his scoring system to formulate a more global theory of the development of a working group. What is important to emphasize is that what is occurring in these efforts are attempts to achieve the goal of a more unifying theory of interpersonal and group behavior by utilizing statistical methods not by combining statistical and clinical approaches.

Some efforts have also been made to use quantitative techniques to code behavior such as feelings, unconscious processes, defense and group climate. The work of Whitaker and Lieberman (1964) and Stock and Thelan (1958) is indicative of efforts to operationalize and make concrete Bion's impressionistic concepts of group life-work versus the basic-assumption activities of fight/flight, dependency and pairing. The previously-mentioned work of Mann and his associates also focused on clinical variables using the Bale's-type scoring system and dealing with categories such as hostility, affection, power relations, and thematic categories.

Gibbard et al. (1974, p.10) note from their review of the studies attempting to combine the two categories of

methods in small group research: "Trying to combine systematic observation and quantitative analysis with variables familiar to the clinician is a worthy goal that has yielded worthwhile results. At times, though, it seemed as if the work had too many numbers for the working clinician and yet was too impressionistic and subjective for some experimental social psychologists."

McGrath and Altman (1966) assessed small group behavior research methodology and identified several characteristics of concern. One was the wide variability in "rigor and methodological sophistication" in various studies from case studies to complex experimental investigations on large samples of groups. A second problem area identified was the settings for small group research most of which was conducted in laboratories and few in natural settings. A third problem area noted was the tremendous diversity of terms, concepts and operations which were used and the relative lack of replication of studies in general and on substantive variables in particular. These authors reported that they found only one instance of "near replication" among the hundreds of studies they examined and this was in the area of the interrelations among group cohesiveness, pressures to conform and productivity (p.68). McGrath and Altman also observed that "the small group field seems to be shot through with idiosyncratic concepts and labels used by only one investigator and his disciples. Without the development of a common-shared language, they see continuing difficulties in the growth of a body of knowledge. McGrath and Altman (1966, p.69) cite three more specific needs to be met to achieve the goal of systematic accumu-

lation of knowledge: (1) more replication of studies, (2) more terminological rigor, even standardization, and greater concern with the task of construct validation. Finally, in addition to changes relating to replication of studies, selection of terms, construct validation of operations, and choice of research strategies and settings, McGrath and Altman emphasize that the use of appropriate data collection and analysis approaches for investigating multivariate interdependence in small groups must be practiced as well as preached.

Glanzer and Glaser (1959, 1961) provided a comprehensive review of the work on group structure and behavior, first within the context of the analysis of structure and later as an effort to document empirical studies of the effects of structure in small groups. In the former study, they reviewed techniques for analyzing the structure of groups that had been permitted to form their own patterns of interactions, whereas in the latter study they reviewed studies in which experimenters imposed structures and measured the effects on performance. In both papers, the substantive area of interest was communications structure.

Glanzer and Glaser (1959) described a variety of mathematical techniques related to the measurement of the interactions of communications of a group, its structural characteristics. Focusing on the mathematical techniques growing out of sociometry, they describe the potential contributions in areas such as construction of indices for group and individual characteristics, the enumeration of structures, comparison of groups, analysis of subgroups, assignment of individuals to subgroups, and graph theory

application to problems of group organization. Glanzer and Glaser (1959, p.331) note that the mathematical techniques must become better known and applied, but then "in most cases they will probably be helpful only in clarifying the requirements for adequate descriptive or explanatory systems. At best, these techniques will provide the variables to be incorporated in such theories."

In their second paper, Glanzer and Glaser (1961) grouped the empirical studies reviewed under the following headings: the initial work, variations and further analysis of the basic design, mathematical analysis, emphasis on the distribution of functions in the simulated team, and emphasis on feedback and learning. The significance of the empirical findings is discussed in a later section of this report. Of interest here are theory and methodological considerations. Glanzer and Glaser (1961, p.26) conclude, "at the present time, there is still a major need for a system to order the data already obtained and to direct further work on the effects of group structure. The difficulty in constructing this system may arise from the inappropriateness of either the experimental situations or the concepts that have been used. Attempts have been made to remedy both of these possible defects. The success of these attempts will determine whether this review is a prologue or an epitaph."

The above trends in theoretical and methodological developments in small group behavior indicate potential opportunities for enhancing past team and team training research, particularly for emergent situations. A more in-depth review was therefore conducted based upon the encouragement received from the above results.

Several substantive areas were selected for review both as indicative of trends and as potential areas of contribution to the development of unifying concepts between team training and small group behavior. Theoretical developments in experimental learning, group development, group productivity and performance, and group motives were examined and are described below.

The work of Kolb and Fry (1975) provides insights into efforts to develop an applied theory of experiential learning. This theoretical work has its base in the Lewin contributions on group dynamics, the subsequent developments in the laboratory training method and T-groups, and the methodology of action research in organizational development. The conceptual orientation encompasses change and growth best facilitated by a closed-loop process involving immediate experiences, observations about those experiences, analysis of that data and feedback of the conclusions for use in modifying present behavior and choice of new experiences (Kolb and Fry, 1975). Argyris (1975) notes in his review of new directions in experiential learning that "learning processes that excluded cognitive dimensions, deemphasize task achievement and effectiveness, while emphasizing warmth and interpersonal closeness, left themselves open to serious questions of whether they could achieve their purpose of educating the whole person." Kolb and Fry (1975, p.34) similarly state that "the experiential learning model emphasizes that learning and change result from the integration of concrete experiences with cognitive processes: conceptual analysis and understanding." This model also includes the role of individual differences in learning style, the concept of growth and development, and a model of learning environments that is commensurate with the experiential

learning process. With reference to the latter area, a central concept is that tension and conflict characterize experiential learning and the learner needs different abilities to deal effectively with these conditions. The four basic adaptive modes or ways of relating to the world are concrete experience (CE) versus abstract conceptualization (AC), and active experimentation (AE) versus reflective observation (RO). To accommodate this concept in the theory, a learning style inventory provides an identification of four different learning abilities related to the four modes. A typology based upon dominant learning abilities includes covergers (AC/AE), divergers (CE/RO), assimilators (AC/RO), and accommodators (CE/AE).

In addition to the emphasis on individual differences in learning styles, the theory also emphasizes growth and development and normative approaches to these. A three stage development process from birth to full adult life include acquisition (to adolescence), specialization (early adulthood to mid-career) and integration (through adulthood). Growth is seen as proceeding from dependence and defensiveness to self actualization, independence and self-direction. The stage of specialization is particularly of interest to military training since it covers the period beyond adolescence through mid-career. Kolb and Fry (1975, p.41) describe this stage as follows: "Specialization, extends through formal education and/or career training and the early experiences of adulthood in work and personal life. In this stage development primarily follows paths that accentuate a particular learning style. Individuals shaped by social, educational and organizational socialization forces develop increased competence in a specialized mode of adaptation that enables them to master the particular

life tasks they encounter in their chosen career (in the broadest sense of that word) path. This stage, in our thinking, terminates at mid-career although the specific chronology of the transition to stage three will vary widely from person to person and from one career path to another."

The final elements emphasized are the role of the environment, the person-environment interactions, and the development and use of models based on theory to design and implement learning situations. The authors (p.52) set forth three theoretical implications, based on elements of theory discussed, for an applied model of environments: (1) environment must be more broadly defined than in current formal educational approaches, (2) observable and controllable factors in the environment can be related to individual differences as expressed in behavioral learning styles, and (3) person-environment interactions must be related in the content of growth and development goals for the learner.

Based upon a survey of more than 100 students who had completed an introductory, experientially-oriented course in human factors in management, Kolb and Fry developed a tentative typology in terms of personal growth dimensions discussed earlier: affectively-complex environments, perceptually-complex environments, symbolically-complex environments, and behaviorally-complex environments. In distinguishing between preference models and contingency models for matching environments to learners, the authors point out that in addition to typical educator or employer goals, the learner's growth and development needs must also be taken as goals, and determinations of environmental factors must include distinctions between what the learner likes, wants, needs or prefers. Military team training traditionally has not included these

goals, and the narrow task orientation in the application of ISD precludes consideration of such goals.

Throughout the literature on small group behavior the distinction is drawn between experimental social psychology knowledge based on experimental, hypothesis testing, laboratory-based research with its reliance on statistical data, laboratory manipulation of variables and social psychological "laws," and the experiential social psychology knowledge based on either naturalistic-clinical approach using subjective and clinical inference as essential to observations of groups in various settings. These two points of view are restated to invite attention to the criticism that the former research is sometimes criticized as being "sterile, dry, and of little value to those professionals who deal with groups on an everyday basis" (Gibbard et al., 1974; p. XIV). The theory of group development reviewed below, with its conceptualization based in group dynamics, might provide some insights into whether work in this area can provide theoretical and empirical support to the experimental area in becoming more useful to practitioners.

Bennis and Shepard (1974) report on their efforts to develop a theory of group development based upon observations made over a five year period of teaching graduate students group dynamics. The theory focuses on problems involved in improving the internal communications systems in groups. By giving attention to the organic properties of groups, the authors believe that criteria can be developed by which phenomena of development, learning and movement toward maturity can be identified. Maturity means that the group can resolve its internal conflicts, mobilize the resources, and take intelligent action if it has a means for consensually validating

its experience. The authors state (p.129) "the core of the theory of group development is that the principal obstacles to the development of valid communication are to be found in the orientations toward authority and intimacy that members bring to the group. Rebelliousness, submissiveness, or withdrawal as the characteristic response to authority figures; destructive competitiveness, emotional exploitiveness, or withdrawal as the characteristic response to peers prevent consensual validation of experience. The behaviors determined by these orientations are directed toward enslavement of the other in the service of the self, enslavement of the self in the service of the other, or disintegration of the situation. Hence, they prevent the setting, clarification of, and movement toward group-shared goals."

The group moves from preoccupation with authority relations to preoccupation with personal relations. These two phases authority (dependence) and personal (interdependence) have three subphases. In the dependence phase, the three subphases are dependence-flight, counterdependence-flight, and resolution-catharsis. This phase deals primarily with the distribution of power, and ends with the acceptance of mutual responsibility for the fate of the group and a sense of solidarity but the implications of shared responsibility have yet to be explored. During phase II, which has three subphases, enchantment-flight, disenchantment-flight, and consensual validation, there is a change in emphasis from power to affection and from broad role distinctions such as class and professional interests to personality modalities such as reaction to failures, warmth, anxiety and retaliation. According to Bennis and Shepard (p.149) communications is facilitated by members of the group's acceptance of each other's differences, conflict over issues is substantive and

not emotional, consensus is reached through rational discussion and an evaluation process, and members are able to accept their own involvement and other aspects of the group process without alarm. These changes also create a deeper understanding of how other persons feel, think, and behave, and it is the catalytic role of unconflicted members which represents the power to move the group. By the introduction also of "barometric events," e.g., removal of the trainer to help resolve dependence and the evaluation-grading requirements at the termination of the course, provisions are made for the catalytic agents and resulting process to occur. Additional data and experiences are necessary to establish the influences of these action-producing events.

Tuckman (1965) reviewed 50 articles dealing with the developmental sequence in small groups for three different settings, i.e., therapy-group studies, T-group studies, and natural- and laboratory-group studies, and two stages of group development, i.e., interpersonal relationships (group structure) and task activity. Tuckman proposed a conceptual model as a set of hypotheses of changes in group behavior in both social and task realms across all groups over time. The model took the following form:

Stage	Group Structure	Task Activity
1	testing and dependence	orientation to the task
2	intra-group conflict	emotional response to task demands
3	development of group cohesion	open exchange of relevant interpretations
4	functional role-relatedness	emergence of solutions

From a detailed analysis of the studies selected for review in terms of the above structure, Tuckman summarizes the developmental model proposed in terms of four stages: forming, storming, norming and performing (pp.397-398). In the forming stage the group initially concentrates on orientation and testing to identify boundaries of both interpersonal and task behaviors. Also dependency relationships with leaders and co-workers or preexisting standards are established. The second or storming stage is characterized by conflict and polarization around interpersonal issues, and emotional responses in the task situation. These behaviors serve as resistance to group influence and task requirements. During the norming stage, ingroup feeling , cohesiveness, new roles and new standards evolve, and intimate, personal opinions are expressed. In the final stage, i.e., performing, the interpersonal structure becomes the "tool of task activities." As a result of roles becoming flexible and functional, group energy is channeled into task activities, and, with structure issues unsolved, structure becomes supportive of task performance.

Tuckman believes that the studies reviewed are suggestive although the available data cannot substantiate the above model. Particularly the studies do not deal with rate of temporal change, permit calculations for rate of change for each stage, or systematically study the effects of a variety of independent variables on development. The model may, however, provide a framework for investigating these elements which do relate to team operations and team performance needs.

Most definitions of groups and teams include the concept of goal directed behavior. Zander's (1968, 1971)

theoretical orientation encompasses group goals and group motives as distinct from individual member goals and motives. His investigations place emphasis on members' plans or actions "in behalf of the whole group regardless of personal gain to be received from participation in the group's work." Also, working groups are considered to be more likely to be more effective when they have a clear criterion of success since this type of goal helps members to define the members' tasks, coordinate their actions, and develop efficient work procedures. According to Zander, group member's awareness of accomplishment and feelings of satisfaction give rise to several useful group properties such as a stronger desire for group success, increased level of effort, more effective coordination, less strain in interpersonal relations, and greater member attraction. This focus on group level of aspiration as a particular kind of goal takes into account both the conditions of the group and individual motives. Some of the conditions which might influence individual member's choice of a future goal for an operating group include selection of the performance level that can be reasonably attained, satisfaction associated with various levels of group achievement, influence of externally-developed information about the group's future, variations in the members' strength of desire for group success, and personal dispositions toward group membership and participation in developing group goals. The nature of the goal itself can also determine the events which occur within a group, i.e., levels of performance, members' pride and commitment, attitudes and beliefs, and the contamination of the group. Both aspects of group motives and aspirations are included in Zander's theoretical orientations.

What little research support exists for Zander's theoretical and methodological approaches results from studies in group dynamics rather than group decision-making or problem solving, and to some degree from studies in "risk taking." Study results on the nature of cooperation, cohesiveness and group performance in dynamic groups are suggestive. Zander could find little descriptive data or relevant theory relating to the origin of group goals and the interest of members in these goals (Zander, 1971; p.4). The working assumptions Zander employed to investigate how a group develops its future expectation included:

1. the ends that members select for their group are part of the unit's ongoing work procedures, subject to change as a result of feedback on group performance. The feedback model stresses the importance of the relationship between performance achieved and what is desired, and the involvement of motivated behavior.

2. to accommodate the presence of individual behavior in group decisions and activities, four sets of relationships need to be considered including (a) members's goal for the group, (b) group's goals, (c) group's goal for a member, and (d) member's goal for self, which are concepts about an individual and are properties of the group.

3. most important, group level of aspiration is a suitable type of goal for initial study, assuming that a group aspiration may be conceived as an analogy of a personal aspiration.

4. Group level of aspiration is defined as the "score members expect their group will attain in the future." The rationale for deciding upon this working assumption include (a) the origin and changes in level of aspiration give operational meaning to the stages of the feedback model above, (b) a fairly standardized procedure exists for studying the level of aspiration and related concepts, (c) evidence is available that a group can influence a member's personal aspiration by establishing a group level of aspiration, and (d) findings from previous research on individual aspiration provide a way of judging intuitively if groups, when they set their goals, differ in some way from individuals, when they set their goals.

The concept of group achievement motivation is based upon research by Atkinson and Feather (1966) and McClelland (1961, 1965). The "need to achieve" experimental research focused the need on the achievement of the group by limiting the feedback to information on group performance. Investigation of the focus on group versus personal success was encouraged by McClelland's work on achieving societies.

Zander (1971, pp.176-198) ordered the findings relating his efforts and that of others to provide a theoretical framework for explaining why aspiration processes function as they do. The structure for the ordering took the form

of assumptions and hypotheses presented under the below-listed topical headings within each of which four kinds of results are discussed:

Topical Headings	Kinds of Results
1. sources and functions of a group level of aspiration	1. placement of a group's level of aspiration
2. effects of group success and failure	2. motivated beliefs of members
3. reactions to social pressures arising outside the group	3. evaluation of performance
4. group-oriented motives	4. performance of the group
5. person-oriented motives	
6. group's aspiration	

Zander (1971, 1968) has been able to demonstrate that a variety of conditions contribute to the improvement of group performance including arousal of members to possess a high degree to desire for group success, increasing goals higher than past levels of successful performance, providing feedback on group scores as well as individual scores, enhancement of group performance due to increasing difficulty of the task affects those oriented toward group needs whereas feedback arouses those with strong personal motives. The congruence between a member's goal and the group's requirement is greater if the member's task is more relevant to the work of the group, the group presses the member more strongly to perform at a particular level, the goal is a moderate challenge, and the social pressures are noncoercive.

Hare's (1976) conceptual scheme for the analysis of human interaction is relevant to resolution of issues related to the definition and analysis of a team. Hare considers interaction of members the distinguishing characteristic of a group versus a collection of individuals. Citing the work of several researchers, he identifies four features of group life in addition to interaction which typically emerge as a collection of individuals develops into a group. These are: (1) members share one or more motives or goals which determine the direction of the group, (2) members develop a set of norms which set boundaries for interpersonal relations and activities, (3) a set of roles becomes stabilized as interaction continues and the group becomes differentiated from other groups, and (4) a network of interpersonal attraction develops among members (Hare 1976, p.5).

This set of characteristics can be compared to the minimum set from Hall and Rizzo (1975) developed as a consensus from a sampling of various authors' definitions: (1) be goal- or mission-oriented, (2) have a formal structure, (3) have assigned roles, and (4) require interaction among members. These authors emphasize that a decision as to whether team training should be given to a particular group of individuals should be based upon criteria applied within this framework. Recognizing the similarity between the small group and team training characteristics, it appears desirable to examine the methodology of Hare's conceptual scheme for its potential use in increasing our understanding about fundamental issues in teams and team training.

The basic elements of Hare's scheme are man's biological nature and personality and his environment, with interactive behavior as a compromise between the needs of the individual and the demands of the environment. The relationship of the elements affecting the interaction of group members may be examined from the point of view of process, structure, or change. Process involves the analysis of act-by-act sequence of events over time. Structure involves the same analysis at a point in time. Social change typically focuses on changes in the structure of a group over time. The categories of behavior suggested for interaction analysis are interpersonal (e.g., cooperative problem solving), intrapersonal which includes individual performance as well as tension and anxiety. Two categories described for representing the major dimensions of observed behavior are form (e.g., communication network) and context (task behavior) which also include provision for input and output characteristics. The analysis can be applied to behavior, personality and role. Both formal and informal structures are considered. Group members must solve problems at both the group level and the individual level, at which there are both task problems and social integration problems. Satisfaction of own goals prior to participating in group organization and tasks is the usual case. Conformity to norms is necessary to solve problems at all levels. Groups must meet four basic needs in order to survive: (1) L - share a common identity and possess a commitment to the values of the group, (2) A - possess or be able to generate necessary skills and resources to reach the group goal, (3) I - have rules for coordinating activity and enough feeling of solidarity to stay together to complete the tasks, and (4) G - provide sufficient leadership and

control to be effective in reaching their goal. Groups usually develop in the order of the above phases (Hare 1976, pp.16-17).

Hare's emphasizes the importance of the task as the most general way of specifying the expectations for group behavior. The task of the group in the broadest sense is to deal with the situation in which it finds itself. Tasks are described in terms of six variables: (1) kind of task (goal), (2) criteria for task completion, (3) rules (or roles) which must be followed, (4) method for imposing rules, (5) amount of stress on members, and (6) consequences of success or failure (Hare 1976, p.258). This concept of task can be contrasted with the classic concept of task reflected in Miller's definition as quoted in Meister (1976, p.96): "A task is a group of discriminations, decisions, and effector activities related to each other by temporal proximity, immediate purpose and a common man-machine output." What Hare's concept suggests, as do other related concepts of tasks, is that the classic concept of task and the related methodology of task analysis may be the most limiting constraints in efforts to develop an operationally-usable definition of a team. Perhaps the conclusion by Meister (1976, p.151) that "very little information is available about how tasks are performed in the real world context" should not be interpreted as meaning tasks as classically defined but rather as tasks whose characteristics and dimensions transcend the narrow concept of man-machine interaction and encompass much more of the total environment.

Steiner (1972) sets forth a group productivity theory, "modest in scope," stressing the integrative role of task

demands and group process. The basic formulation centers on the manner in which task demands specify the need for and use of resources, the adequacy of resources determines the potential (maximum) productivity, and the appropriateness of processes determine the degree to which actual productivity approximates potential productivity. To further elaborate on this formulation, Steiner presents a partial typology of tasks which includes divisible versus unitary tasks, maximizing versus optimizing tasks, tasks which permit members to combine their individual products (disjunctive, conjunctive, additive, and discretionary tasks), and tasks which prescribe the process to be employed as well as those which are permitted. In a disjunctive task the group can accept only one individual's contribution as the group's own; in a conjunctive task the rules rather than the group dictate selection of the individual who is the worst performer. An example of the latter is the speed with which mountain climbing speed is influenced by the slowest member. Additive tasks are group determined, i.e., combination of individual contributions equally-weighted. Discretionary tasks permit the group to select its own process for combining individual contributions.

Steiner (1972, pp.40-66) describes options in specifying the division of tasks into subtasks and the matching of specified-unspecified division of tasks and specified-unspecified matching of individuals and subtasks for divisible tasks. In the majority of cases of combining several subtask outcomes into a group product, the process is likely to be disjunctive, and in real life, the integrative process is performed by the group to develop a complex product. When division and matching are specified, actual productivity will fall below potential productivity when members fail to perform

up to the limit of their resources within their assigned roles. In the unspecified case, the group must make organizational decisions as to who will do what, and actual productivity will be heavily influenced by the system of matching and specifying selected.

Throughout the exposition of his theory Steiner emphasizes the importance of process and the dependence of prescribed process upon the nature of the task and the size and composition of the group which permit us to specify who should do what and when in order to be productive. Use of suitable payoff systems helps to motivate members to perform their role more effectively in the prescribed process. Steiner stresses the concept of the group as a system and the view that "process is the essential bond by which members are held together in relationships that impart a quality of wholeness to the group. A group cannot be productive for very long unless it survives as a system, and survival requires that the group cope with its environment" (p.185). Steiner concludes by noting that the most troublesome unanswered questions concern the goals which group action should be directed rather than the manner in which it can be directed.

Hackman and Morris (1975, p.46) conclude from their comprehensive review that in spite of the thousands of studies of group performance conducted over the past several decades, little is known about why some groups are more effective than others, and even less is known about what to do to improve the performance of a given group working on a specific task. The main thrust of their approach for understanding group effectiveness is on the role of the interaction process and explicit quantitative assessment of how group interaction affects group performance. In reviewing several conceptual

approaches to understanding group processes, which Hackman and Morris refer to as speculations, they identify the "pessimistic" view of Steiner who addresses process losses; the improvement in quality of solutions, i.e., freedom from error, stemming from the interactions among group members; the negative effects of "groupthink," that interaction can sometimes result in "assembly effect bonuses," and the views of organizational psychologists from their work with experiential training groups or with team building activities (p.48). The authors point out that "there are substantial data which show that training activities can powerfully affect both the nature of the interaction process in groups and the quality of members' personal experiences. But the few studies that have tested the effects of such changes on actual task performance generally have yielded ambiguous or negative results (for reviews see Herold, 1974; Kaplan, 1973) (Hackman and Morris 1975, p. 49).

Hackman and Morris, using a paradigm adapted from McGrath (1964, p.49), present an organizing framework for examining the relationships among the initial state of a task-oriented group, the group interaction process, and the group's ultimate performance effectiveness. Interaction process is defined as all observable interpersonal behavior that occurs between two arbitrary points in time ($t_1 - t_2$). The concept specifies that the state of all system variables may be assessed at any given "slice" in time and the input-output relationships may be examined for short or prolonged periods of time. The underlying assumption is that the variations in group performance can be identified by a careful analysis of the interaction process which mediates between input and output.

The authors cite research evidence from studies which deal with input-process relationships, process-performance relationships, and the full input-process-performance sequence. Numerous input factors have been identified as affecting group interaction including leader attitudes, member personality characteristics, group history or experience, group structure, and particularly the nature of the task. Hackman and Morris report that little research has been conducted on the relationship of group process characteristics to performance outcomes. Earlier laboratory research of Lanzetta and Roby (1960) found that measures of group interaction predicted task performance better than measures of task relevant knowledge and training procedures. The way the group uses its resources and the procedures it employs were found to be at least as important as knowledge of the problem. The previously described research of Steiner (1972) has suggested that this process can be systematically investigated through a weighting approach for selecting or rejecting group members solutions.

In an attempt to provide supporting evidence for the hypothesis that group interaction mediated input-performance relationships, Hackman and Morris investigated the input-process-performance sequence using intellective tasks classified as production, discussion and problem solving tasks. The findings from these studies, and other reviewed by the authors, indicate that group processes are strongly related to group performance outcome as reflected in statistically reliable relationships but there is little understanding of the substantive aspects of the input-process-performance relationships.

Hackman and Morris (1975, pp.56-61) describe several methodological and conceptual limitations of research which account for the failure to demonstrate how group interaction process mediates between input and output states. These include (1) inadequate interaction coding systems which do not contain any conceptual or operational link between the behaviors measured and the determinants of group effectiveness, (2) failure to directly relate interaction sequences to the task goals and strategies being pursued by group members, and to develop procedures for longitudinal study of groups larger than dyads, (3) need to deal with inconsistent relationships between group process and group performance for different types of tasks, (4) limitations of research setting, e.g., laboratories, which hold as constant variables which are known to have important influence on interpersonal behavior, and (5) conservative strategies for investigating the cultural norms which effect group behavior.

Hackman and Morris (1975, p.61) propose a three pronged research approach to group effectiveness involving the functions of the interaction process, recasting the role of input factors, and experimentally creating nontraditional structures and process. With regard to the functions of the interaction process, three summary variables are proposed for controlling the variation in measured group performance thereby making the management of the large number of input variable feasible.. The three summary variables are: (1) effort brought to bear on the task by group members, (2) task performance strategies used by group members, and (3) knowledge and skills employed by group members. Group interaction is viewed as affecting effort primary through the coordination of efforts of individual group members, and by affecting the

level of effort group members expect (task motivation). Performance strategies are defined as more than procedures; they involve collective choices about how members go about performing the task "and desirable performance outcomes." The interaction process can affect performance strategies by fostering the implementation of strategies shared by group members, facilitating the reformulation of shared strategies, or developing new ones. In the area of knowledge and skills application, interaction processes function in assessing and weighting the differential contributions of group members and in creating conditions within the group to optimize the use of all knowledge and skill available. These influences may be particularly important in preventing significant "process losses" due to inadequate interaction processes, and more importantly produce "process gains" associated with each of the summary variables.

The second thrust of the Hackman and Morris interaction process approach involves the manipulation of certain input factors to improve the level of group effectiveness than might ordinarily be expected from the contributions of the summary variables. The specific input factors selected are the structure of the norms which guide member behavior, the design of the group task, and the composition of the group, i.e., characteristics and histories of group members. More specifically, Hackman and Morris are proposing that performance strategies can be made more task-appropriate by modification of group norms, the level of member effort can be increased by task design, and group knowledge and skill levels and application can be improved by manipulating group composition.

The third element in the proposal by these authors is

research on experimentally creating nontraditional structures and processes effecting group effectiveness. Noting that this area has received almost no systematic investigation, Hackman and Morris (1975, pp.84-87) report on one study involving three intervention conditions relating to planning strategies (strategy, antistrategy, control), and exhortation or absence thereof, four-persons groups, and two-task conditions (unequal information and equal information). The results indicate that the strategy intervention (first a preliminary task then the primary task) did successfully alter the interaction process of the experimental groups. Another important finding was that the control groups did not discuss strategy spontaneously suggesting the need for training in strategy utilization. Members of the strategy intervention groups showed more interpersonal problems but also greater flexibility in their task approach in changing procedures when needed to improve performance. Members of these groups also perceived themselves as high in leadership and influence, unlike the members of the other two groups, which Hackman and Morris suggest reflects the creation of a condition of participative leadership. The authors conclude that this research suggests that it is possible to create new, nontraditional norms in groups, to trace their effects on group effectiveness, to affect the group interaction process through interventions, and these changes lead to measurable differences in productivity.

In summary, Hackman and Morris propose that group interaction process is a major determinant of group productivity, that some selected "input" variables significantly influence group performances and can be manipulated to bring about desired results, and that three "summary variables" (effort, performance strategies, knowledge and skill) summarize the

most powerful proximal causes of group effectiveness. The general strategy suggested for achieving progress in understanding and managing these various group influences is by development of smaller theories specific to elements of the performance process or to performance effectiveness under specific circumstances (Hackman and Morris 1975, p.88).

Davis (1969) set forth a theory of group performance with emphasis on social interaction and combinatorial processes involving individual preferences. Social interaction "implies that the behavior of one person is in turn a stimulus as part of a stimulus complex for the behavior of a second." Davis views group behavior as a function of three classes of variables: person variables, environmental variables, and task or goal associated variables. Further, the focus on group performance is on group product, group structure and group process about which he believes "any attempt to segregate overlapping and continuous phenomena rests on uncertain ground" (p.5). The primary question for Davis is how individual task-oriented behaviors are weighted, combined or whatever in order to produce a distinct group product. Central to his theory is the development of theoretical baselines against which real group performance can be compared. By use of this normative approach, Davis believes an adequate theory of group performance for some situations can be approached more quickly. Baselines are conceptualized as social combination schemes for translating members contribution to the task into a group product. One example cited by Davis (p.44) is identifiable as an average, as in Stroop's discussion of group judgments in comparison with judgment of the average member of the group. A variety of other schemes have been put forth for pooling member contributions in judging, problem solving and learning

tasks (e.g., Taylor, 1955; Lorge and Solomon, 1955; Hoppe, 1962; Steiner, 1966; Laughlin et al., 1968; Zajonc and Smoke, 1959; and Taylor, Berry and Block, 1958). The general conclusion from examining these approaches is that "the direct performance advantage displayed by groups has a rather simple explanation in a number of cases. More precisely, there exists a simple pooling hypothesis concerning member products that is at least sufficient to explain a rather wide range of group-individual results on decision-making, problem solving, and learning tasks. However, the model developed by Taylor and by Lorge and Solomon does not explain all group performance. It has frequently overpredicted group performance, and this deviation remains to be explained in many cases. Furthermore, many different kinds of groups have not been studied in this individual-into-group manner, and hence their performance cannot be considered in light of this or other social combination hypotheses. The task and other circumstances frequently do not permit either empirical or mathematical construction of concocted groups" (Davis 1969, p.47).

Davis (1973) proposes a general theory of social decision schemes aimed at accounting for the distribution of group decisions by using formal hypotheses about the effects of social interaction when the inputs are individual member preferences. Davis distinguishes group problem solving as emphasizing the processing of information to construct response alternatives to fit specifications laid out in the stem of the problem from decision-making as emphasizing the selection of a response from a set of mutually exclusive and exhaustive alternatives. The concern in both cases is with the social interaction processes, i.e., combinatorial processes, which in problem

solving are termed social combination process and in decision-making are termed social decision schemes. The model proposed is a transformation of the probability distribution characterizing individual differences to a group distribution over the same alternatives. Davis' considers this individual-into-group model similar to Steiner's (1972) group productivity model as well as other waiting time and group dicision models, except that he considers his model to be a general case model extending to any n and r. To quote Davis (pp.123-124) "the formal derivation herein led to an extremely simple expression that permitted a very convenient representation of (the social decision matrix, D) the hypothetical social process leading to a decision. The matrix form of the social decision schemes to be transformed into precise predictions about group decision, but might even be thought of as a "picture" of the task social system that has at least some interpretation by direct inspection." The social decision matrix is focused on tasks or problems that require a sequence of choices, and developing estimates to fit this matrix may provide a direct estimate of that which may be difficult or impossible to observe directly. The viability of assumption that the social decision scheme remains constant for some set of trials, time intervals, or items must be demonstrated to determine the validity of the estimation procedure. Davis' research has included exploring various distributions (positively skewed, bimodal, symmetrical, and uniform) and social-decision schemes, equiprobability, majority with a proportionality subscheme, and averaging.

As previously noted one of the fundamental issues relating to groups and teams is that of defining group or in ways that are meaningful both theoretically and

operationally. As Hall and Rizzo (1975) emphasize, failure to develop the concept of team limits greatly progress in team training and team performance. The following discussion of theory and definitions of "group" relates not only to the foregoing substantive areas but also to the applied problems of teams. As such it provides some new insights and potential sources of new apprcaches for investigating the concept and definition of teams.

Smith (1967) reviewed much of the theoretical literature on the theory of the group and definitions used by various scholars in the field. Integrating the research relating to the definition of group, he proposed a definition to "simultaneously optimize the evaluative criteria of parsimony, conceptual clarity, and scientific utility." Smith's definition includes "(1) the largest of two sets of two or more individuals jointly characterized by (2) a network of relevant communications, (3) a shared sense of collective identity, and (4) one or more shared goal dispositions with associated normative strength" (p.141). One objective of this definition is to overcome the previous limitations of definitions which have been too broad or too narrow thereby ignoring the distinctive, emergent structural properties of groups. The first element, group size, is intended to be inclusive of every individual in space-time who satisfies the definitional criteria. The second element, network of communications, requires that each member has received at least one communication relevant to the existence and purposes of a particular collective unit, and that each member of a set is connected with every other member by a finite number of relevant communication links. No specifications regarding time period, means of communication, or originator of the message are involved.

Relevant information relates to the flow of information about the existence, purposes, norms, etc. of characteristics of a collective entity. By collective entity is meant the abstract image of a group or group-like phenomena. Accordingly, two defining characteristics of a group are that every member received information at least once which dealt with the existence and main goal of the group, and a finite number of communication links be identified between a given member and any other member.

The third element, a shared sense of collective identity, involves an observable condition in which each member perceives himself to be member of or participant in some specific collective entity and believes that others exist who share this same perception, that is a belief in mutual membership and in unity, an intellectual rather than emotional commitment. An emotional commitment is a variable rather than a defining characteristic.

The fourth element, shared goal disposition, is the tendency to want or prefer some end-state or configuration of events, which is recognized reciprocally by each member. Associated normative strength is the sense of rightness or sense of social duty to accomplish the share goal. This involves the requirement to have at least one norm present, that of accomplishing the goal. The main shared goal is mutual interaction rather than some specific set of instrumental actions although these are necessary for preserving continuity of identity.

The above definition of group is considered by Smith to be of maximum use because its elements represent a "critical mass" in a real empirical sense. This means

that there should be a sharp increase in the probability that grouplike phenomena will occur once observable configurations of events satisfy the four definitional requirements. Grouplike phenomena are concerted self-conscious and other conscious thoughts, feelings or actions on the part of a set of individuals (Smith 1967, p.150). By knowing that several individuals form a set and knowing the global nature of the group goals, norms, roles, etc. the total variance in behavior may be predicted to some significant degree without having additional information available about each member. Groups structure their behavior in such a way that it is more predictable than generally is the case for an equal member of individuals not forming a group. This group structuring is termed "supraindividual patterning of behavior" (Smith 1967, p.150). The increased predictability occurs not only in current but also future behavior. Once formed the group tends to have a future of its own distinct from that of individual members. Pursuit of common goals results in development of a variety of mutually supporting grouplike phenomena such as normative strategies for goal implementation and formation of group representatives and interaction. Grouplike phenomena are sequences of highly interrelated event configurations which at any point in time are systematically and probabilistically related to future grouplike phenomena within the same set. "The explication of grouplike phenomena may be further refined by stating that the emergent grouplike phenomena are complex events that not only manifest a predictable supraindividual patterning of the present and future behavior of multiple individuals but which also permit such increased predictability without primary dependence on sheer physiological-genetic causation or on the coercion of external environmental factors" (p.151).

To provide the empirical referent for the term group, the idea of self-conscious unity among members who manifest hightened predictability is added which can be used to distinguish groups from non-groups. The results of these considerations provide an external criterion for the scientific utility of any definition of group.

Smith also identifies internal evaluative criteria for the definition of group which refer to the connotation or inherent logical structure and content of a definition (p.153). The definition should include only as many elements as are necessary to denote the phenomena of interest and no more (parsimony), and should be precise and operational by providing clearcut rules for application of certain of its component terms to real world observable events, and clearly defining all of its component terms (p.154).

Each of the four elements of the definition, group size, communication network, shared collective identity and shared goal disposition are evaluated by Smith in terms of the criteria above. The results are summarized below and are shown to be elements of a definition of group necessary for the emergence of grouplike phenomena. Reading "group" as team provides some insight into their potential for use in satisfying the fundamental requirements for a theory based and operationally-usable definition of team.

1. group size - when two or more individuals satisfy the stated criteria for membership, a group exists; groups include all members - past-present-and future; a larger number of emergent group-like phenomena occurs as group size increases; groups are dynamic and continually changing in nature

2. communications network	-	similar patterns of learning, necessary for predictability of group-like phenomena, develop through communications which must meet the criteria of relevancy; i.e., relevant to the defining elements - collective identity, shared goals, etc.; neither direct nor face-to-face, nor two-way communication are necessary since grouplike phenomena emerge from much simpler networks
3. shared collective identity	-	a shared sense of identity unity is essential for concerted, conscious grouplike phenomena to occur with any degree of regularity; this is the cohesive force which distinguishes the group from a collection of individuals
4. shared goal dispositions	-	one or more shared goal dispositions with associated normative strength must be present; role differentiation, patterned actions by members, development of group actions and group representatives, growth of norms and the like can emerge only if the motivational and instrumental unity necessary is provided by this element; shared goal disposition is all critical to regularity of behavior; the normative strength portion provides the cohesiveness that goes beyond self-interest in achieving shared goal disposition

In addition to the question of necessary conditions for the emergence of grouplike phenomena, Smith also considered the matter of sufficiency (parsimony) in terms of several other analytic aspects of groups. The results of his assessment are summarized as follows:

1. face-to-face interaction - generally considered relevant for defining small groups rather than groups in general

2. norms regarding means - except for one norm related to shared goal disposition not necessary for formation of a group and not necessary for defining a group; norms concerning means develop over time

3. role differentiation - defined as differential task allocation, this is not necessary for defining a group; if role differentiation is negligible, so is functional interdependence

4. action - possible for groups to exist at a level of shared thought, feelings and goal disposition without overt actions

5. duration	-	contrary to views of Bogardus and Verdú, Smith asserts that endurance through time is not a defining element of a group
6. external perception of group identity and group membership	-	being perceived by nongroup members as having essential group elements not necessary; this is a variable characteristic of groups; other researchers argue the contrary view
7. socioemotional pattern	-	these are variables rather than defining characteristics for all groups
8. mutual and satisfaction	-	necessity cannot be demonstrated although it is a frequent occurrence; Bates and Bobchuk, Hare, Williams disagree
9. intergroup relations and group representative roles	-	not necessary for the emergence of grouplike phenomena; occurs after the emergence of a group

Smith notes that his four definitional elements, as well as those discarded above, yield dimensions, and their long-term value lies in serving as crucial dimensions. Further Smith states (p.164): "Thus it becomes an empirical question whether and to what extent groups are characerized by face-to-

face interaction, by norms guiding group goal accomplishment, by endurance through time, by a collective identity perceived by outsiders, by role differentiation and functional interdependence in the accomplishment of tasks, by positive interpersonal choices among the members, by the provision of various sorts of satisfactions to the members, by overt action, by representative roles, or by other characteristics which have not even been considered here. All of these characeristics may be seen as forming a property space of important elements of groups, so the general scientific problem to be faced is to explain movement through this property space in a systematic way." Smith also emphasizes that having a precise definition of groups permits the conduct of much needed research such as prevalence rates and determinants of rates for all kinds of groups, determination of number of groups and sampling of groups rather than sampling group members, group formation and rate of group formation, and group development, growth and change, and general social theory. The critical aspect of Smith's approach, i.e., the strategy of "focusing on emergent group-like (team) phenomena and building a construct suitable for denoting this empirical reality" seems particularly applicable to the requirements of teams, team training and team performance. The need for advances on both theoretical and empirical levels has long been recognized. For example, Lorge et al. (1958) reviewed the literature on group performance in problem solving, noting the various and often artificial definitions of "groups" (statisticized, climatized, concocted, ad hoc and traditional) and cautioning against generalizing principles developed for specific groups until underlying assumptions relating to each group were validated.

This section of the report has examined developments and trends in theories and methodologies in both team training and small group behavior research. Few recent advances or research projects in team training have been identified. Team training concepts appear to be heavily influenced by unconfirmed findings such as that individual proficiency achieved in training is the keystone to required team performance. In contrast, the review of the small group behavior research literature indicates an increasingly large number of publications. A multitude of potential contributions are described for developing new team, team training and team performance concepts, and employing more sophisticated research strategies. Theoretical and methodological contributions are available from several substantive areas such as experiential learning, group productivity, group growth and development, group interaction analysis, and group theory and definition. These developments are discussed in terms of potential contributions to resolving basic questions relating to team concepts, growth and development of teams as units, analysis of team tasks and performance, and associated team training strategy requirements, particularly an Instructional System Development model for teams.

4.0 FINDINGS ON SUBSTANTIVE VARIABLES

4.1 Introduction

This section of the report addresses substantive findings from research in the team training and small group behavior areas including group performance. The objectives are to review these findings and to determine what relationships might exist across disciplines in terms of variables associated with the two previously-discussed elements of the instruction system development model, i.e., development of training requirements and operational evaluation of training. The former element requirements are viewed principally in terms of team definition, analysis and development concepts. The second element requirements are examined in terms of team performance and operational evaluation of training.

The organization of this section focuses first on findings from team training research and then on small group behavior similar to the organization of the preceding section covering theory and methodology. Efforts were made to prepare a matrix composed of team training and small group behavior findings using the ISD structure (Table 1, p.24) and Altman and McGrath's (1966, pp.104-105) classification scheme. This approach was found not to be feasible for several reasons, particularly the wide variations in definition of terms and experimental designs. A detailed descriptive analysis was conducted to identify suggestive relationships which offer opportunities for further development and potential operational applications to team training and team performance.

4.2 Team Training

Briggs and Johnston (1967) reviewed and summarized team training research, including their own series of ten laboratory investigations conducted during the period 1963-1967. Findings are discussed in terms of (1) task variables, (2) training variables, and (3) communication variables. From their review and synthesis, these authors developed suggested principles of system design and training, which are often quoted in the literature. Several difficulties associated with these principles need to be considered. Some of the difficulties are: (1) almost all of the research findings are from laboratory investigations, (2) the principles are not relatable to a team training theoretical foundation, (3) although presented as "suggestive," the principles have not been systematically tested, and (4) contradictory evidence has developed since 1967, e.g., Klaus and Glaser (1970) findings of decrements in performance under a parallel structure as a result of the redundancy which produces interference between skilled and less skilled workers.

Perhaps what has been lost sight of in the publicizing of these suggested principles is the following quotation from Briggs and Johnston (1967, p.25):

"But can we now conclude that individual training is superior or at least not inferior to team training? We hesitate to do so for there still are those real-life training situations, and obviously, intelligent system managers do not spend funds for team training when such is not necessary. Further, the RAND-System Development Corporation research on team training (Chapman et al., 1959) has produced some interesting and persuasive theory (Kennedy, 1962), and we hesitate to reject that long-term program and its basic assumption that team training is necessary.

Perhaps the answer lies not so much along a coordination dimension, as we assumed in designing the tasks for Experiments II and V, but conceivably the dimensions of system complexity and input complexity and uncertainty more directly determine

TABLE 2 - VARIABLES REPORTED ON BY BRIGGS & JOHNSTON (1967)

Task Variables	Training Variables	Communication Variables
1. task organization/ structure	1. task fidelity	1. verbal communications
a. centralization	a. equipment/ procedures	a. content analysis
b. parallel vs. serial	b. skill requirements	2. team interaction
c. team organization	c. input fidelity	3. team proficiency
2. system load	d. output fidelity	4. time
a. systematic variation	2. performance feedback effects	5. coordination
b. load balancing	a. intrinsic KOR	6. communication discipline
c. load and training	b. extrinsic KOR	7. information channels
3. operating procedures	c. information content EKOR	8. interoperator behavior
a. flexibility	d. complex feedback	9. reciprocal/ nonreciprocal
b. procedural planning	3. individual vs. team training	10. appropriate/ nonappropriate feedback
	a. team member replacement	11. stress conditions
	b. previously working together	12. communication and team performance
	c. training received as individual vs. training as a team	a. amount
	d. team coordination	b. types
	c. system complexity input complexity and uncertainty	
	4. operator replacement	

whether individual or team training is the more efficient training procedure. Certainly, full-scale air traffic control operations and an air defense system such as SAGE are complex, and the total input to these systems is considerably more variable and less precisely sensed than were the inputs to the radar control tasks utilized in the present series or the coded inputs in the Horrocks et al. studies. Under these levels of complexity and input uncertainty the basic concepts proposed by Kennedy (1962) all argue strongly for team training; one cannot develop a system awareness, an integrated model of the (complex) environment, or exploit fully the self-organizing capability of large teams without team training.

Therefore, we do conclude that highly-skilled team performance in complex systems does require team training. But, we can still ask the question: how much team training relative to individual training? The question has not been the subject of empirical test in truly complex systems. We predict the answer would be most interesting."

The following conclusions were drawn regarding the cited variables in the summary report (Briggs and Johnston, 1977):

1. team structure - a hierarchical structure is more reliable, requires less training and permits an open communication system

   parallel substructures within a hierarchical structure are preferred to serial structures because team performance is less dependent on the least skilled worker and load balancing is more easily carried out

2. interaction - minimum interaction between team members fosters superior team performance

3. load - teams can learn to adapt to an increase in load on the system provided the operating procedures permit such flexibility

4. feedback - debriefing sessions following team training sessions help through KOR. Conclusions from the literature include: (a) KOR helps shape behavior in those team tasks which contain relatively little feedback, (b) individual-specific KOR (rather than total team KOR) is desirable when one man to compensate for the deficiencies of his teammate(s), (c) KOR must be controlled rather carefully by the instructor to meet the unique needs of different stages of training, and (d) teams attempt to maximize those aspects of performance about which they receive specific and simple KOR even though other aspects of team performance may suffer in the process

5. operator replacement - operator replacement can have a temporary deleterious effect on team performance especially if the replacement is less skilled than the man replaced

6. coordination - intrateam interactions involving verbal communications are an index to the level of team coordination present

7. communications - with training, teams exhibit progressively less volume of communications and the pattern of these messages change as a function of both training and task variables

    1. four general characteristics of communications between members identified relate to: (1) reduction of input uncertainty, (2) evaluation of what is known, (3) examining courses of action, and (4) leadership control messages develop
    2. leadership control results in a discipline on the team in their communications
    3. time stress fosters communication discipline, i.e., fewer communications, more objective information content
    4. availability of information messages in a system markedly influences the content of team communication

5. the volume and control of communications can be controlled by immediate feedback but such feedback can produce unusual effects on performance

6. laboratory research on team communications indicates that the less interoperator interaction, the better

8. individual vs. team training - direct evidence for the superiority of team training over individual training does not exist

The above-cited research by Chapman et al. (1959) investigated the concept of the team as a synthetic organism of which the members are components. Rather than limiting the observations to input-output conditions and then inferring what transpires between the two, these researchers focused on the process of adaptation by the team to emergent characteristics of the environment, emphasizing cognitive aspects of learning. The development of coordinative skills is stressed as being essential to team members knowing what to do, when to do it, and particularly why they should take particular actions. As a result each member will not only perform his job effectively but will facilitate rather than interfere with other team members. The concepts which form the foundation of the

development process include an awareness of the total system by each member and the relationship of his task to all other tasks, an understanding of the characteristics and functioning of the environment and the relative importance of various events, and the development of innovations for better organizing and performing team activities. As Chapman et al. (1959, p.267) write: "Our research indicates that these are the conditions necessary to promote organizational learning: clarify the goal, give the organization as a whole experience with tasks of increasing difficulty, and provide immediate knowledge of results."

Some of the specific findings from their investigations of four crews in RAND's Systems Research Laboratory were:

1. organizational goal - each of the four crews (3 USAF and 1 college student) gradually came to behave as if it were a real-life situation becoming deeply involved with the organization's goal and its successes and failures

2. team skills - members of each crew became an integral unit in which many interdependencies and coordination skills developed. As each crew learned to perform more effectively, the learning showed itself in procedural short cuts, reassignment of functions, and increased motor skills to do the job faster and more accurately

3. feedback - "debriefings" following each session were considered crucial to learning and led to improved performance but the content of these discussions could not be related to crew development

4. load - crews continued to operate very effectively though the task was increased threefold; discrimination of important from unimportant information and development of short cuts occurred

5. stress - stresses from increasing task load (failure stress and discomfort stress) were viewed as positive factors in improving performance

Glanzer (1962) summarized a series of team training investigations, conducted over a period of years, designed to identify the structure, functioning and training problems of Navy operating teams. Other objectives included determining the relevance of experimental and social psychological research on group structure and efficiency to these requirements, and reducing the critical aspects of team activity to laboratory proportions. The direct examination of operating team structure and activities in terms of network of interactions or communications involved measures of interaction, centralization, overloading, coordination and extra-team input. The findings on these variables are summarized as follows:

1. interactions - in the teams studied a member responds to another member only at a given point in the sequence of team actions; the sequence is almost completely fixed; i.e., deterministic not probabilistic

2. centralization - contrary to expectations, although highly centralized with regard to rank and responsibility, teams were not centralized in the communications or interaction sense

3. overloading - problems of overloading of the communications channel or heavy requirements with respect to coordination not found

4. coordination - teams showed successive coordination but not simultaneous coordination

5. extra-team input - very little input generated from the general environment or other teams carrying out related work

Glanzer concluded that if team performance can be viewed as a chain of individual responses, there are several reasons from an efficiency point of view for minimizing team training.

Addressing the matter of input requirements as a critical factor in considering individual vs. team training, Glanzer states that team training cannot be dispensed with because all inputs used by team members cannot be specified for use in individual training. For example, two special cues are hard to produce: (1) cues from special aspects of other team members' activities, such as sounds of other members, and (2) cues from the entire chain of preceding actions. Glanzer (p.382) writes, "in summary it was found that the team is a complex organization of interlocking responses whose proficiency could theoretically be reduced to the proficiency of the individual composing it. The success of such a reduction, however, would depend on much more information about teams than is currently available."

With regard to the examination of team training procedures, several administrative as well as training content (obsolete equipment, etc.) problems surfaced. Other problems noted were absence of satisfactory proficiency measures, limits of time for testing, and technical deficiency of measurement approaches. Error data was collected over a five month period on a total of 506 exercises from 72 different ships using CIC, ship control and gunnery teams. Errors were analyzed with respect to frequency of occurrence, team positions and types of activities involved. The general results related to team training procedures were: (1) error rates were somewhat higher for higher ranking team members than for lower ranks, (2) only a small proportion of errors were corrected within the team, (3) the responsibility for error correction in most cases was not clear. The emphasis on individual team member errors, rather than through any higher order coordination of personnel, and inefficiency in correcting these errors, were contrary to initial expectations.

Glanzer's examination of the experimental and social psychological literature for potential contributions included attempts to set forth a comprehensive set of variables or dimensions to describe groups, techniques of group structure analysis, the relationship of attitudes, perceptions and motivation to group performance, studies of the use of special techniques for the improvement of group performance, studies of the relation of individual proficiency to group performance and studies of communication networks. Two areas selected for review were the group network studies by Lanzetta and Roby and Rosenberg and Hall. Glanzer notes that the Lanzetta and Roby studies touch only tangentially on training, whereas Rosenberg and Hall approach the problem more directly (Hall, 1957; Rosenberg, 1959; Rosenberg, 1960a; Rosenberg, 1960b; Rosenberg and Hall, 1958). These latter authors define structure in terms of information feedback and the composition of feedback. Glanzer believes the findings from these laboratory studies are of less interest than the general approach which involves examining experimentally a central part of the team training process experimentally, and it moves the team training problem into the area of learning theory (Glanzer, p.399). Specifically, Rosenberg and Hall (1960) reduced social interaction to feedback conditions and prepared the way for investigating theoretical needs through learning theory. Glanzer concludes that much of the previous work on groups has been directed at the problems of motivation and organization, and more recent work has directed attention to the mechanics of training the individual within the team setting. He notes also a growing appreciation of the special characteristics of the actual team as opposed to the laboratory discussion group.

Glaser and his associates conducted a series of laboratory studies of team performance and learning theory (reinforcement) during the period 1960-1967 (Klaus and Glaser, 1968; Klaus and Glaser, 1970). Two- to four-man teams learned to respond to stimulus light presentations with lever-pressing responses of

two to four seconds duration. The emphasis in these studies was on viewing the team and team products as a whole thereby providing the opportunity to investigate the effects of various conditions of team reinforcement on team proficiency. Subjects were all male, senior high school students paid on an hourly basis for their participation. All subjects, both operators and monitors, received individual pretraining in the timing skill used as the basic team response. The theoretical framework for the various studies was based on research which has shown that frequency, pattern and accuracy of an individual's response can be reliably modified during training, and the resulting performance levels maintained by carefully controlling the reinforcing events in the individual's environment. Application of similar techniques to affect team functioning was the objective of these investigations.

1. reinforcement of team responses - group performance curves showed similar learning curve characteristics as individual performance; apparent improvement in team performance over time explained by temporary decrement in individual proficiency upon entering team performance reinforcement. (Study 1)

2. team acquisition and extinction - team response acquisition, team response extinction, spontaneous recovery, response reacquisition, and response reextinction as changes in output proficiency were investigated. Three principal operational conclusions drawn were:

"(1) it is feasible to view a working team as a single performing entity, having response features which are directly affected by the feedback from team output; (2) individual practice by team members, under certain conditions, may be ineffective in maintaining subsequent team proficiency when feedback about team performance is withheld; and (3) the initial proficiency decrement that may occur when trainees are transferred from the individual practice condition to team training appears to be a function of the changes in the schedule of reinforcement between the two training conditions." (Study 2)

3. decrements in parallel teams - investigation of the effects of redundancy, i.e., adding a monitor on team performance for parallel teams indicated that reinforcement contingencies set up by the structure of a parallel team can result in a performance decrement after an initial increment in proficiency as a function of continued reinforcement practice. (Study 3)

4. team arrangement - the effects of three types of team arrangement were studied: (1) series, (2) parallel and individual (only one member need respond correctly), together with various reinforcement contingencies. Initial proficiency varied significantly (.01 level) in the order of parallel, individual, series. Comparison of change in performance from initial to final trials during team practice indicated slight improvement for series, decline for parallel, and slight increase for critical members of the individual teams. (Study 4)

5. team composition and membership - proficiency of individual members, ability of members, delay in initiation of team training, and team structure were studied using a series team arrangement. The principal finding was that differences in team learning can be specifically related to the proficiency which the individual team member attained during individual pretraining. (Study 5)

6. supplementary reinforcement - investigated the effect of furnishing supplementary individual reinforcement early in team response acquisition training, recognizing the sensitivity of change from continuous individual reinforcement to intermittent reinforcement produced by a series team arrangement during the early course of team training. Results indicate that the combined use of team and individual reinforcement led to more rapid development of team proficiency, and that the facilitating effect of individual reinforcement was lost when this added feedback was no longer provided. (Study 6)

7. team environment simulation - investigated team environment simulation through study of the effect of a change in reinforcement schedules in going from individual to team training, and to investigate the decrement in proficiency induced by a change in reinforcement schedules (lean, full intermittent, continuous) and three cuing conditions (full, delayed, none). Results indicated that what is actually observed in team performance can be explained by the change in reinforcement frequency. (Study 7)

By way of summary the authors conclude that their investigations have demonstrated that the proficiency is affected by collective reinforcement, and that, at least generally, the course of team learning parallels the course of individual learning when subjected to similar operant conditioning procedures, and that the attainment of a team is predictable from a knowledge of team arrangements and individual team member proficiencies.

Klaus and Glaser suggest several guidelines for the training manager for training teams or for maintaining existing levels of proficiency:

1. team practice should result in clear and immediate reinforcement following each correct response; practice in the absence of team reinforcement for criterion level performance is more than likely to lead to a decrement in team proficiency.

2. adding a redundant member to a team to work in parallel with an existing member at a particularly sensitive position can be expected to result in an eventual net decrement in team proficiency.

3. team training is likely to proceed most efficiently when the individual members have thoroughly mastered their own specific assignments beforehand.

4. experience with the conditions of team reinforcement seems to be critical for successful individual training of potential team members. Matching reinforcement schedules during individual and team training is desirable.

5. the probability of a correct team response, as computed from knowledge of team structure and the proficiencies of intended team members is quite likely to be a maximum rather than an expected value, that is, below predicted level.

Meister (1976) recently reviewed much of the literature on team training as part of his broader efforts related to team functions in man-machine systems. As in the case of other reviewers, Meister raises questions and identifies research gaps concerning distinctive team elements, the similarity of team training and individual training, the sequence of training for individual and team training, whether team training is effective in increasing system output, and the relationship between variables that influence team performance training and individual training. Citing various illustrative studies, Meister draws the following conclusions regarding team training:

1. team learning - on the surface team learning exhibits the same performance curve displayed by the individual operator (p.268)

2. individual vs. team training - individual training is superior to team training for simple or only moderately complex tasks. Team training appears to be relatively ineffective in producing performance beyond that resulting from individual operator training (p.270)

3. fidelity of training - high fidelity training conditions are important determiners of operational task performance where fidelity refers to equipment, procedures, or skill requirements. Input fidelity is more crucial than output fidelity (p.271)

4. feedback - knowledge of results - given incompatible criteria of system performance such as speed and accuracy, teams will emphasize that aspect of performance about which they receive knowledge of results (KOR),

even though other aspects of system performance deteriorate as a consequence. If criteria are changed, team performance will be modified quickly to emphasize that aspect of performance which was previously neglected. Concurrently, team performance on the other aspects will deteriorate. However, if the team changes from a single criterion to several criteria, teams will continue to stress that aspect of performance about which they had previously received KOR (p.273)

5. task complexity - team training, like individual training, is affected by task complexity. Training is, of course, easier and performance superior on less complex tasks. Task organization in team training is a less significant variable than task complexity (p.276)

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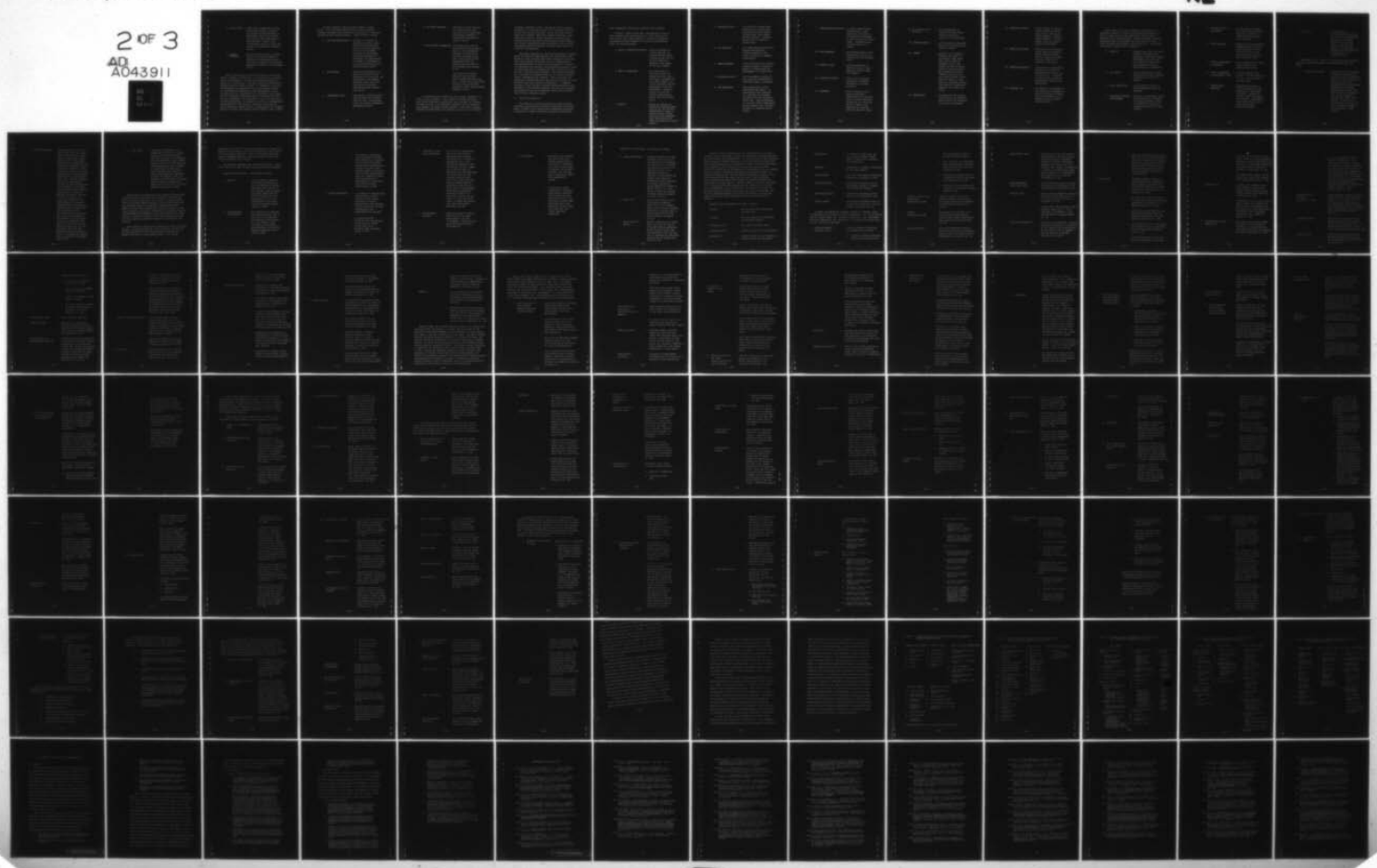

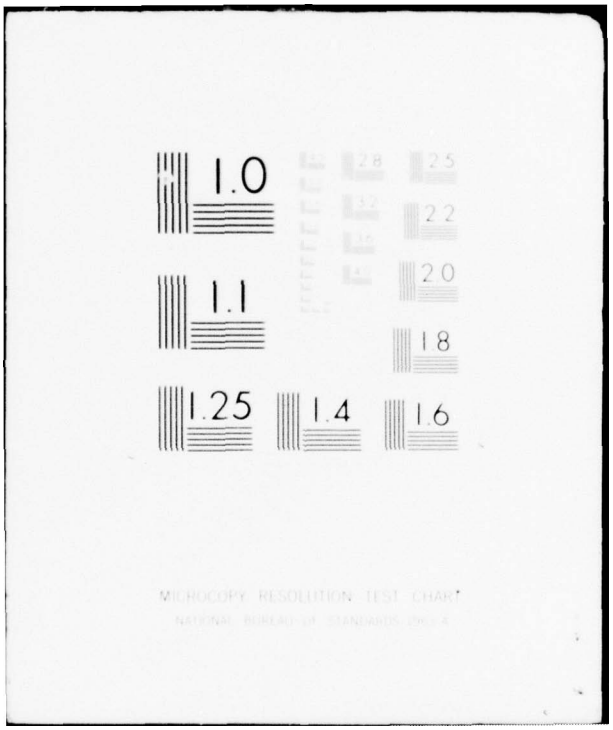
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6. reinforcement - individual reinforcement during early team training overcomes the characteristic decrement in proficiency that occurs during the transfer from individual to team training. However this reinforcement does not reduce the amount of team practice required (p.276)

7. training flexibility - during training, teams in highly uncertain situations should be provided with opportunities outside system operation to establish operating procedures and principles (p.277)

Some of the specific technical problems identified by Meister include (1) difficulty in specifying what should be taught in "teamwork," (2) team training effectiveness is likely to be fortuitous if training cannot be controlled by specifying what is being learned, (3) inadequate attention to development and application of group learning curves, (4) methodological problems of determining what a group learning curve as a combination of individual curves means, and (5) inadequate information about task characteristics for both determinate and indeterminate tasks in relation to training mechanisms. In proposing a series of developmental implications for the design of training of prospective system operators, heavy reliance is placed upon the recommendations of Briggs and Johnston (1967) (Meister 1976, p.288).

In their review of team training research, Wagner et al. (1975) included some additional recent research findings regarding team training and performance in emergent situations which deserve mention. These findings include:

1. prior motivational states - contrary to findings in laboratory studies, prior motivational states were found to be less important in field team studies; training in coordinative skills was important to compensate for deficiencies in member's performance or to overcome temporary situational problems (p.18)

2. team awareness - existing technologies, e.g., split or multiple screen techniques of television, can effectively train members regarding their roles and the need for effective communication and interaction (p.23)

3. interpersonal skills - preliminary research results indicate that CAI training does not have a discernible effect on company commander's performance (p.24)

4. low fidelity simulation - available findings showing low transfer from team training to the operational environment centered on established situations not emergent (p.26)

5. team structure & composition- increasing task load did not affect team performance when all the information necessary to perform the task was available to the team; teams showed better performance when all members were included in the communications network (p.30)

team member replacement findings from research under established conditions (i.e., little effect generally) conflict with operational experience under high personnel turnover (p.32)

In summarizing the results of their review, Wagner et al. (1975, p.32) concluded: "The research findings discussed above which show that a particular team structure is "better," or that one type of reinforcement schedule is more effective than another, are quite fragile results. They can be largely obviated by such things as a lack of fidelity in the training

situation (Campbell, 1971). The nature of the training situation is a critical element to be concerned with for future team training research. Up to now tasks used to study team training, with some notable exceptions, have been quite limited. Recent programs in the Army have demonstrated the possibility of developing high fidelity, yet low-cost simulations which may provide team training researchers with the controls to study "team skills" in realistic environments."

The above collation of team training research findings points to potential opportunities for integrating information but also provides additional evidence for the view that team training technology is still underdeveloped. Conceptualizations of team training contained in section 3.0 concerned with providing environmentally-oriented training opportunities for learning and skill acquisition have not been researched and developed. The limited knowledge base available is composed primarily of laboratory-based theory, methodology and findings. There have been few substantive contributions for dealing with problems of team definition and team training requirements. A complete strategy of team training oriented toward operational performance as the principal dependent variable has not been and probably could not be designed solely from available team training research results.

4.3 Small Group Behavior

The question to which we now turn is what findings from small group behavior research, including team performance, related to the theoretical developments discussed in section 3.2 might contribute to dealing successfully

with fundamental team issues including team training.

Meister's (1976, pp.285-287) comprehensive review of team functions and team performance, using illustrative case studies and a large number of references related to man-machine systems resulted in a series of conclusions which are presented below:

1. group vs. individual performance - group performance is usually superior in problem-solving tasks, although groups may not be cost-effective because of the number of men they require

2. small vs. large groups - the superiority of group performance in problem-solving tasks is manifested primarily in very small groups (i.e., as one proceeds from the individual to the two man-group). Groups of larger size are not usually significantly better than the two man-group

3. monitors - adding an observer in monitoring improves detection of the two minitors independently. Teams of monitors adopt various strategies for combining their performance, but these strategies are rarely optimal

4. organizational size - in industrial systems there appears to be a curvelinear relationship between organizational size, work output and work quality. Organizational size is related to absence rate

5. crew composition - crew composition significantly affects crew behavior, evidence relating to the effect on output is somewhat inconclusive

6. member replacement - little description on team performance results if only one member is involved and the replacement is of equal skill

7. performance variance - team performance variance is only partially determined by individual member performance

8. team organization - team organization in part determines team output. A hierarchical team structure is a favorable arrangement provided it is not strictly a serial one. Team performance in a serial task is determined by the weakest link, and overloading is a distinct possibility

9. indeterminate organizations - in highly indeterminate organizations, teams experience difficulties in organizing themselves to come to grips with their tasks. Information processing tasks are an example

10. team organization - the effectiveness of team organization varies as a function of task characteristics

11. division of labor - system performance is generally superior when tasks are divided among team members

12. procedural flexibility - except under emergency conditions, procedural flexibility is highly desirable

13. interaction - both in training and in actual performance independence (non-interaction) is highly desirable. Interaction at either the input or output level distracts the operator from task specific duties

14.	independence/load balancing	- both independence of function and load balancing are needed for superior team performance
15.	redundant personnel	- adding redundant personnel may have both positive and negative effects
16.	feedback	- operators will attempt to maximize the aspect of performance about which they receive specific feedback, even at the expense of other team performance characteristics. When changes are made in feedback criteria, team successfully adjust except when the change is from single to compound criteria when team will continue to emphasize the single criterion
17.	communications	- non-task-required communications during crew-performance reduces the effectiveness of the performance

18. communication channels - visual methods of communicating information within the team are superior to verbal channels. Adding a verbal channel to a visual channel does not produce superior performance

19. communication structure - differences in performance result from differences in communication structure, the more direct the transmission permitted by a structure, the better

20. communications patterns - variations in communication patterns are related to performance but not in any one-to-one way. Training in communications does not significantly improve team performance

21. motivation, etc. - the amount of information on the effects of motivation or other attitudinal variables on crew performance is too sparse to permit drawing any conclusions

Davis (1969, pp.77-87) reviewed a large amount of available research in terms of individual performance in a social context and the ways individuals combine their behaviors into a group product. He then reviewed available knowledge about environmental and human qualities that might influence performance at the group level. The following summary reflects Davis' findings:

1.	group size	-	changes in personal and interpersonal processes (e.g., feelings of inhibition, group geography) that occur with an increase in group size have primarily negative implications for performance
2.	eye contact	-	invites interaction, occurs more between friends, implies credibility, difficult to measure
3.	group composition	-	is difficult to relate to task performance except at extremes
4.	intellective abilities and performance	-	measures of individual ability are insufficient predictors of group performance, which is affected by interactive discussion and personal conviction

5.	personality traits of group members	- present pregroup measurements have marginal status; they have seldom been validated against actual social behavior
6.	group cohesiveness	- develops from interpersonal attraction within a group and/or because goals are best achieved by group action and are in accord with individual goals
7.	effects of cohesiveness on performance	- can be distracting as interaction becomes more important than tasks
8.	effects of performance on cohesiveness: a cycle	- "Nothing succeeds like success." Group failure can also be a spur when due to external forces
9.	cooperation and competition	- cooperation behavior is found in groups which are rewarded as a whole when successful, competitive behavior where individuals are rewarded. Cooperative groups have higher performance records than competitive groups.

10. norms - are determined by (1) behavioral expectation, and (2) limits of tolerable deviations about this expectation. Positive (praise, approval) and negative (expression of displeasure) sanctions lead to convergence to a collective norm

Helmreich's et al. (1973) review of performance research includes social facilitation, task performance and risky shift.

1. social facilitation - current view of the presence of others, whether as co-acting or observing increases the general drive state and thereby increases the probability that the dominant responses will be made, assuming that a high drive state inhibits the acquisition of new responses (Zajonc 1965, 1966, 1970); presence of others is a learned source of drive and not an innate biological drive (Cottrell, 1968) (p.344)

2. task performance - major concern has been with task, group size, and group composition with less attention to group member interaction and the interaction between group composition and situational variables such as task meaningfulness, and few attempts to conceptualize and operationalize a multivariate approach or to study changes over time. Findings reported by various investigators include (1) group productivity is a function of the interaction between member ability, interpersonal relations, position structure, and kind of task, (2) contrary to laboratory findings, group effectiveness in research organizations was correlated negatively with occupational and educational level, heterogeneity and group size, (3) groups of intermediate heterogeneity displayed less tendency to structure their tasks and outperformed homogeneous groups, and (4) task structures were the more powerful (than task organizations) in influencing achievement, consistency, and matching (p.345)

3. risky shift - a variety of approaches, e.g., leadership, diffusion of responsibility and familiarization, have been followed; less cohesive, more heterogeneous groups exhibit greater risky shift than cohesive and homogeneous groups; findings on leader behavior and parsimonion provide weak support on this relationship and controlled research is lacking; risk is a cultural value and when individuals receive relevant information about other's risk level, shift to greater risk levels (p.346)

Davis (1973) reviewed theory and research involving the actual interaction of two or more people in a cooperative, mixed-motive, or competitive relationship in group problem solving and group decision-making. Davis (p.503) notes that most research studies on cooperative group performance emphasize either group composition (ability relative to the task, personality variables, leadership), situational factors (reinforcement contingencies, group organization), or group process. Further he points out that the "ideal study would of course explicitly consider composition, situation, and process."

With regard to cooperative interaction in group decision-making, it was noted that the focus in America for the past 15 years has been on risk-taking whereas in Europe the emphasis has been on "group polarization." The latter

hypothesis is stated as "the average post-group response will tend to be more extreme in the same direction as the average of the pre-group responses." Many of the design and data analysis problems plaguing group polarization studies much as they do choice shift studies.

The following findings were selected from Davis' report from a large set, some of which have already been described:

Cooperative Interaction: Group Problem Solving

1. ability	-	recent research indicates that group performance is a joint function of ability and group size relative to task demands, and that overall group performance can often be predicted from a knowledge of the ability composition of the group apart from process considerations (p.503)
2. reinforcement contingencies	-	more effective in altering participation rates when it was given to individuals and applied to individuals, but more change in the perception of the other group members resulted from feedback applying to the group (p.505)

- in comparing performance and intragroup attraction under competitive, cooperative and individualistic reinforcement contingencies, arousal was higher, performance better, and attraction to other group members lower for competitive than either cooperative or individualistic conditions, which did not differ significantly (p.506)

3. group organization - in studying coordination and collaboration, results indicated higher group productivity without collaboration when coordination was required, and with collaboration when coordination not required

a suggestive study indicated that interacting groups are more likely to intervene in an emergency than co-acting groups (p.506)

4. individual versus group performance - superiority of cooperative pairs over individuals demonstrated is concept attainment for a variety of conceptual rules, task difficulty conditions, and interaction formats; comparable findings found on importance of group decisions for group decision from research on risky shift; such clear superiority has not been demonstrated on production tasks such as those used on brainstorming; mathematical aggregation rules were superior to behavioral concept for very small or large likelihood ratios in comparing individuals and group process conditions (p.506)

5. interpersonal learning - through training to rely on different cues to understand others' criteria in judgments, acquisition of new skills and be facilitated (p.507)

6.	motivation	- decrement in performance has been found to be roughly proportional to the number of coordination links between pairs of members; in Steiner's analysis, the loss was due to motivation rather than coordination (p.508)
		- literature on group productivity, drive and cohesiveness indicates that productivity and cohesiveness tend to be positively related under high group drive and negatively related under low group drive and normal operating conditions

Cooperative Interaction: Group Decision Making

1. group composition - McGrath and Altman's (1966) argument that the crux of the composition-performance relation in the patterning of different amounts of an attribute is yet to be addressed seriously; problems of measurement and control and conceptual inadequacies have continued to prevent unambiguous group composition studies of choice shifts (see risky shift) as they have studies of other group performance variables (p.510)

2. group size - group size continues to be a relatively unpopular topic, as it is throughout small group research, perhaps because of a general lack of theory which defines size as an important parameter (p.511)

3. social process factors - popular explanation of choice shift stresses the role of individual change preceeding group decision rather than the possibility that the process of aggregating individual preferences can produce the shift (p.511)

Steiner's (1972) typology of tasks outlined below provides a structure for considering a variety of substantive findings relating to group process and productivity. It will be recalled that Steiner's objective was to examine empirical literature dealing with the processes and productivity of comparatively simple task-oriented groups with emphasis on the findings from laboratory investigations. Central to the theory he suggested are the concepts that task demands and participants' resources determine maximum productivity, i.e. potential productivity, and that process determines whether or not the product will be more than just the sum of the individual. Actual productivity equals the potential productivity minus the losses due to faulty process. Steiner (1972, p. 9) points out that from this perspective the question of the superiority of groups or of individuals is not a meaningful one because the answer is dependent upon the nature of the task, the fund of resources, and the ease and dependability with which individuals or groups can employ the process that transform resources into high quality products.

Steiner's partial typology of tasks includes:

unitary	-	one or more persons must each do whole job
division	-	parts of task can be performed by different members
maximizing task	-	how much or how many only
optimizing task	-	requires correct or best outcome
disjunctive	-	product of one or more members is used as output for the group

conjunctive	- all members perform task, but like a chain, weakest member decides outcome (vs. strongest for disjunctive)
additive	- combination of outputs contributed by all group members
discretionary	- group can weigh member performance arbitrarily according to skill
permitted process	- tasks differ regarding the way they permit members to combine their individual products
prescribed process	- process for achieving maximum success is prescribed by tasks
nominal group	- considering individual output as if part of a group (e.g., if one member successful, all are)

A number of substantive findings contained in Steiner (1972) are discussed below under the following headings: (1) group performance on unitary tasks, (2) effects of group size, (3) consequence of group composition, (4) motivation, (5) payoffs and group type, and (6) systems and process.

1. group performance (unitary tasks) - limiting factors in achieving full productivity include:

    1. failure of status differences to parallel the quality of

		the contributions offered by participating members
		2. the low level of confidence proficient members sometimes have in their own ability to perform the task
		3. the social pressures that an incompetent majority may exert on a competent minority
		4. difficulty in evaluating the quality of individual contributions (p. 38)
intact vs ad hoc crew composition (disjunctive task)	-	regular (intact) B-26 crews' group performance was superior to ad hoc (participating members from different crews) crews (p. 25)
status (disjunctive task)	-	for crews with a history and a future, high status members significantly effect performance, both negatively and positively (p. 25)
conjunctive task	-	not very extensively studied; nature of criterion can determine whether tasks are conjunctive or disjunctive or additive (p. 31)

discretionary tasks	- the quality of the group product depends heavily upon the process the group employs; unweighted average of members' independent judgment was found to be very accurate when process is prescribed a variety of combinational rules may be employed; not appropriate when objective is to maximize performance (p. 37)
group performance (divisible tasks)	- organized groups found to perform many tasks more effectively than individuals working alone (p. 65)
dividing tasks	- social and environmental constraint sometimes dictate that only one of several possible divisions is acceptable (p. 65)
	- in real life, most divisible tasks probably require that a set of outcomes be assembled in a way that generates a complex product (p. 66)
division and matching	- when these are specified, a group's potential productivity is determine by the imposed role structure and by the resources of the members who are required to perform specific roles (p.66)

	- when left unspecified, the group will have to make organizational decisions concerning who shall do what when; group process herein includes both the behaviors by which organizational decisions are made and the implementing actions (p.66)
2. group size	- assuming random selection of group members and a disjunctive task, potential productivity will tend to increase a a decelerating rate as group size is enlarged (p. 103)
	- for conunctive tasks, increases in group size will cause potential productivity to decrease at a decelerating rate (p. 103)
	- when the tasks are additive, the relationship between size and potential productivity will be positive and linear (p. 103)
	- size should not affect the potential productivity of groups that are performing descretionary task (p. 103)
	- relationships between size and potential productivity are more

		difficult to infer for divisible tasks; however, such relationships should be positive and curvilinear, increases in size being responsible for decelerating increases in potential productivity (p. 103)
		- as groups become larger, process losses will ordinarily increase at an accelerating rate (p. 103)
	critical size	- critical size probably varies, being smaller when the task requires rapid, continuous and complex communication than when it does not (p. 101)
		- although the data are very limited, some findings are available for dyads, triads, and larger sizes in relation to actual productivity for selected tasks and group structures (e.g., polarized groups) (p. 103)
3.	consequences of group composition	- not a great deal is known about the effects of dispositional variables on group process, or even about the impact of resources on actual productivity (p. 105)

	- no very satisfactory body of theory of homogeneity - heterogeneity of groups; a theory of composition effects should be concerned with identification of variables on which homogeneity - heterogeneity really matters, and it should relate h - h on these variables to the consequences they are likely to promote (e.g., effects on potential productivity, process losses, or actual productivity) (p. 108)
heterogeneity of resources (disjunctive tasks)	- heterogeneity of members abilities tends to produce high potential productivity, manifested most in difficult tasks; heterogeneity is responsible for large process losses when dispositional qualities affect the weighting process (p. 111)
conjunctive tasks	- homogeneity is likely to be an advantage; process loss should not be greatly affected by h - h homogeneity less likely to generate dissatisfactions (pp. 111-112)
additive tasks	- heterogeneity has no effect on potential productivity but may be responsible for large process losses (p. 112)

	- process losses occur when 1. no provision is made for proportional reward 2. when inequality of members ability is apparent 3. little interpersonal coordination is needed 4. when total amount of payoff is thought to be a direct function of the total resources (p. 115)
discretionary tasks	- little research completed
divisible tasks	- heterogeneity allows high potential productivity but it complicates the matching process and it may have adverse effects on motivation (p. 117)
heterogeneity of dispositional qualities	- although dispositional qualities affect members' ratings of their satisfaction with group experiences and outcomes (see reviews by Mann 1959 and Heslin 1964), evidence concerning the impact of such variables on actual productivity is sparse and contradictory (p. 127)

- effect of dispositional heterogeneity on performance may be expected to depend upon task demands (p. 127)

- when an adequate role system is available to guide collective action, dispositional qualities may have little effect on outcome; in the absence of a role system, heterogeneity may either promote or inhibit task motivation and the solution of organizational problems; evidence sparse and inclusive (pp. 127 & 130)

group size and composition - large groups tend to be more heterogeneous than small ones, though individual members of the former are typically less uniquely different from their associates than are their counterparts in small groups (p. 130)

- large groups tend to have more dominance conflict which create coordination problems (p. 129)

4. motivation - Steiner emphasizes (1) how the motivation of an individual are affected by the presence of others, and (2) how rewards

should be allocated to group members in order to minimize process losses (p. 131)

social facilitation

- effects of co-workers and spectators on individual performance easy to detect but difficult to explain (p. 132)

- some studies suggest that "mere pressure" is not sufficient to produce social facilitation or inhibition (p. 134)

- evaluative apprehension is likely to have a facilitating effect when task behaviors have been well learned and are expected to evolve favorable appraisals. Inhibitory effects may be expected when the opposite is true (p. 135)

- competetive attitudes may be responsible for faster but less accurate performance; or it may result in moderating ones behavior or seeking favorable responses (pp. 135-136)

- modeling one's behavior after others can have either a facilitating or inhibiting effect on

performance depending whether the model performs in accordance with task demands (p. 136)

- the subtle effects above are likely to be overshadowed by the impact of the group's system for allocating payoffs (p. 137)

5. payoff systems

- in many cases the payoffs of one individual are linked to those of other members of the same group, and indirectly to the payoffs of persons in other competitive or cooperative groups (p. 160)

- game theory findings are inconsistent and appear to have limited applicability to most real-life situations (p. 160)

- internal (member to member) payoff relationships and external (group to group) interdependencies affect performance but the evidence is not yet adequate to justify categorical conclusions (p. 160)

- the mediating effects of tasks demands have not yet received much attention, however it is apparent that the prescribed process

depend on whether the task is additive, disjunctive, conjunctive, discretionary or complementary, and payoff systems should be matched to the task (p. 161)

cohesion

- is a consequence of motivation and may be expected to vary as a function of the payoff system that guides the group actively (p. 164)

- attraction to the group reflects members' appraisal of the payoffs they may receive, the subjective probability that the desired payoffs will actually be delivered, and the cost of membership (p. 164)

Steiner (1972, pp. 165-182) provides a variety of evidence for the concept that the group is a system, and the process is the essential bond by which members are held together in relationships that impart a quality of wholeness to the group. He states "Without process, the whole would be nothing but the sum of its parts, and the group could be relegated to the realm of metaphor or illusion. However, the group is an active enterprise in which members reciprocally shape one another's actions. Collective process transforms an assortment of individuals into a sound system" (Steiner 1972, p. 165). Citing the stablizing effects of norms and roles, the importance of shared fate and functional interdependence, the lessons from leadership research, the orderliness of system process, the methodologies available for study of interaction analysis, Steiner presents a body of knowledge useful in developing improved approaches to the study of teams and team performance.

McGrath and Altman (1966) report findings on more than sixty simple and complex substantive variables in their synthesis of the small group behavior field at that time. The authors developed a number of generalizations which they categorized under the following headings: (1) characteristics of group members, (2) characteristics of the group, (3) interpersonal relations in the group, (4) leadership, (5) task performance of the group members, (6) task performance of the group, and (7) the role of personality and social factors in performance.

1. characteristics of group members (members abilities and experiences)	- consistent, positive relationship exists between the capabilities and skills of group members and their performance.
	- relationship is clear using objective measures of capabilities, but much more ambiguous using self-reports (by subject, his fears, or by his superiors).
	- abilities of individual members however measured are not necessarily useful predictors of group task performance.
	- very consistent and positive relationship exists between members' abilities and manifestations of leadership performance, as judged by observers of superiors.

	- members are not good judges of one another's capabilities, except with respect to leadership potential
	- very weak relationship exists between group members' perceptions of one another's skills and objective ratings of morale, cooperation, and various other indexes of interaction processes
personality and biographical characteristics of members	- these characteristics have not been studied very extensively in the small group literature
	- for those studied, there do not seem to be any pervasive or general propositions that emerge
member attitudes	- favorable member attitudes toward the group task and toward the situation seem to be partly a consequence of high social or task status in the group, job autonomy, cooperative group conditions, and induced perceptions of task success.
authoritarian attitudes	- in general, authoritarian attitudes show very little relationship to most interaction

	behaviors and inconsistent relationships with performance on tasks of various types
positions of members in the group	- general proposition is that group members who have high social or task status are likely to have power and use it, and to react favorably to the group
	- status is not only related to power, but also to the individual's commitment to the group and his motivation toward group achievement
	- with respect to task performance, there is very little relationship between the task performance of individual members and their social or task position in the group
	- this type of relationship requires more study as does the relationship between the position of members in the group and the performance of the group as a whole
2. characteristics of the group (group capabilities and experience)	- the more training and experience groups and members have the better they perform as individuals and groups. The

	generalization holds for ad hoc laboratory groups and operational (e.g., military) task groups
	- however, knowledge of group capabilities alone is not sufficient to predict level of group performance (p. 59)
	- little research has been concerned with the way group properties (such as capabilities and level of training) achieve their impact on group performance. Little attempt is made to study how various imput variables produce their ultimate effect, in terms of intermediate processes and events.
group size	- although the general proposition that the smaller the group, the more effective its performance is often substantiated, the situation is very ambiguous
composition of groups	- there is very little research on group composition, and what little there is gives an unclear picture of the role of composition

3. interpersonal relations in the group

- the overall picture suggests the interpersonal attractions, interpersonal communication, and perception of task success may vary inter-dependently, so that a manipulation of any one of them will lead to correlated changes in the other two (p. 61)

- successful induction of greater interpersonal attraction produces greater communication and increased perceptions of group task success

- similarly, successful manipulation of perceptions of group success produces greater interpersonal attraction and communication

- finally, it is possible that increasing the amount of communication among group members will lead to more favorable perceptions of other members and of the group's performance effectiveness, although the latter point is not established in the present body of research information

- in these terms, we can suggest that attraction, perceived task success, and communication constitute an interdependent system of variables

- we can suggest that certain other variables, e.g., cooperative conditions, job autonomy, and high member status, are associated with or are determinants of this system

4. leadership

- groups with effective leaders tended to be characterized by good work relations with other groups, care of equipment, orderliness, and a range of indexes of morale. Effective leaders tend to be characterized by a high frequency of problem proposing, information seeking, and ego-involvement, in addition to the actions used to define their leadership effectiveness. However, they were not distinguishable from nonleaders, or ineffective leaders, on a number of other behavioral indexes

- fairly clear picture of who will emerge as leader or be an effective leader - the member with highest status, skills and training

- far less clear picture of just what behaviors characterize an effective leader or distinguish leaders from nonleaders

- no data in the sample on the task effectiveness of groups that had such leaders, nor on what kind of effect, if any, the presence of a good leader had on task performance of group members

5. task performance of group members (role of member characteristics)

- research supports some common-sense suppositions about the impact of member-level properties on individual task performance in groups:

  1. the higher a person's general ability or intelligence and the greater his task aptitude, the better is his performance in a group

  2. there is a positive relationship between job performance and actual job knowledge, training and experience

  3. the above contrast somewhat with the factors that influence group performance

- personal-social factors, such as member personalities, attitudes, and subjective perceptions, do not have consistently clear relationships to individual performance

	- member estimates of one another's performance capabilities do not relate very well to actual (objectively measured) performance
role of environmental factors	- freedom, a sense of involvement, the requirement to act, and feedback all enhance member performance
6. task performance of the group (role of member characteristics)	- member intellectual and task-relevant abilities (e.g., mechanical aptitude) are not consistently good predictors of group performance; individual job experience is
	- personality and attitudinal characteristics are not consistentl related to group performance, except that the absence of extreme personality characteristics enhance group functioning
	- subjective perceptions of various types (e.g., personal skill estimates or estimates of the skills of others) are not always associated with good group performance

role of group characteristics	- experience as a group (working together for a period of time) has a positive relationship with group performance, as does relatively small size of the group
	- favorable interpersonal relations in the group (e.g., high cohesion, high morale) show unclear effects, although the trend is for high morale and cohesion to be accompanied by better performance
role of environmental factors	- reward and punishment, rather than explanation and illustration alone, tend to enhance performance
	- there are differential effects of types of feedback on group performance (e.g., structured critiques have a more enhancing effect than completely unstructure ones)
	- several work conditions (such as efficient routing of necessary information or direct and rapid access to information) have a positive effect on group performance

- clarity of role definition (e.g., jobs each person is to do and relationships between various jobs) also aids group performance

7. role of personality and social factors in performance

- results are equivocal regarding the effects of personal-social factors on individual and group performance; confused results may be due to methodological problems, e.g., measurement technology

- conceptually, the effects may be nonmonitonic for personal-social factors as contrasted with the monitonic effect of aptitude or experience. Also, the appropriate model of group productivity may be that these factors enhance group performance only within the limits set by abilities, training and experience

- gaps to be filled by research on performance effectiveness of individuals and groups include:

  1. need a better understanding of the sequential linkages that begin with inputs in the

form of member, group and task characteristics, that become manifested in intermediate interactive processes, and that culminate in a performance output

2. too little attention has been given to systematically establishing the links in this complex chain

3. need exists for more sensitive appreciation of the parameters and properties of different types of performance, especially dependent variables of member and group task performance effectiveness

Hare (1976) organized the contents of his review of problem-solving into three categories: (1) group process and structure, (2) interaction variables, and (3) performance characteristics. This section of the report will emphasize findings associated with performance characteristics complementing the previous discussion of Hare's conceptual scheme for interactional analysis.

Hare (1976, p. 329) summarizes the findings on the superiority of the group over the individual as follows:

1.	manual vs. intellectual tasks	- group superiority is usually greater on manual problems than on intellectual tasks
2.	individual superiority conditions	- the group loses its superiority in accuracy and efficiency if no division of labor is required, problems of control are too great, or the group develops a standard of productivity which is lower than that of a separate individual
3.	standards of productivity	- the group develops a standard of productivity which is lower than that of a separate individual; in terms of man-hours an individual is usually more productive

4. accuracy of reporting - because of a tendency to converge on a norm, groups will report fewer but more accurate facts than individuals. However, some increase in accuracy can be obtained by eliminating group discussion and simply pooling the judgments of one individual or of several individuals

5. accuracy of judgment - as a by-product of group discussion, the individual tends to be more accurate in his own judgment after he has heard the judgments of others

6. "risky shift" - under some conditions individuals make conservative decisions when they are alone but shift to more risky decisions after taking part in group discussion. The "risky shift" phenomena is more likely to occur: (1) when the group discussion provides relevant and persuasive arguments, (2) when decision responsibility has been diffused over the group, (3) when

other group members approve risk-taking, and (4) when the experimenter seems to desire a risky outcome. The "risky shift" phenomenon provides a well-documented example of the differences between individual and group problem solving

In addition to the question of the superiority of the group over the individual, Hare (1972) also reviewed the literature with regard to the variables associated with productive groups and with regard to group versus group relationships. The results are summarized below:

1.	general characteristics of productive groups (step-following)	- most productive groups, like most productive individuals, are those which can best carry out the steps in the problem-solving process (p. 330)
	structure - high morale	- groups which have a structure suited to their function and have high morale based on a large number of intergroup friendships will be motivated to try harder and be the most productive

attitudes

- motivation of the group is lowered if some members show an indifferent and neglectful attitude toward the task (p. 331)

group organization

- organized groups are more productive not only because they have better procedures for solving task and social-emotional problems but also because the positions of members in the group are relatively stable and less time need be spent in a status struggle

- self-perceptions of groups indicate that productive groups tend to be aware of characteristics which make them effective (Torrance 1953a with airplane crews)

- groups initially low in productivity can be made more effective either by increasing the task skill through training, by increasing their motivation by paying more attention to them, or by providing other incentives (p. 331)

2. Criteria for productivity (laboratory vs. field)

- productivity criteria for laboratory and field evaluation may be different

effective vs. non-effective crews

- in effective--non-effective combat crews, no differences were found in problem-solving scores, manner of team performance, or the members' perception of their group interaction, but the effective crews were better in use of manpower, completeness of participation, coordination, control, and flexibility

- successful crews describe groups which were better organized and more friendly and had a greater toleration for intermember conflict (Torrance 1973a) (p. 331)

3. satisfaction vs. productivity

- individuals join groups for three general reasons:

  1. prestige of membership
  2. help group reach a goal

	3. value the association with the group members (p. 332)
intermember relationships	- high productivity in the task area is not always associated with productive intermember relationships since the former may sometimes be gained only at the expense of the latter (p. 332)
competition vs. cooperation	- Many examples from competition vs. cooperation studies. Generally competitive groups are less efficient and less satisfying to members
authoritarian leaders	- groups led by authoritarian leaders show results similar to competitive groups since in these groups all members are in competition for status in the eyes of the leader. Productivity is higher and morale lower than for groups led by democratic leaders, although in some research no differences are reported in variations of the two styles. Productivity refers

	to quantity of the output, since the quality may be higher for cooperative groups (p. 332)
self-oriented needs	- groups in which most members have high "self-oriented needs" rather than work toward group goal or the solution of the groups' problems, average member satisfaction goes down along with productivity (Shaw, 1956b) (p. 332)
	- members of groups high in self-oriented need-expression also tended to perceive themselves as less unified, were rated as having more conflict by the observers, and completed fewer agenda items, although their meetings lasted longer (p. 333)
interpersonal conflict	- in another similar study, high consensus was achieved in those groups in which there was interpersonal conflict if the members avoided some of the conflict by

		postponing difficult problems, showing little interest in the task, withdrawing from interpersonal contact (p. 333)
4.	members' personalities	- task requirements are important considerations in selecting members on personality or social characteristics
	member characteristics	- characteristics of members of productive groups: 1. high scores on intelligence 2. cognitive complexity, or, 3. problem-solving reflected in higher levels of education
	patterns of interaction	- patterns of interaction can be influenced in newly formed groups by persons of given personality characteristics; may slow the group's development

leader's personalities - leaders are more effective when their personality closely approximates the group's ideal of a leader (Greer, 1955) (p. 334)

5. compatibility of affectional orientation - incompatibility among members on ability to handle feelings and emotions will decrease productivity and control (Reddy and Byrnes, 1972) (p. 334)

6. social characteristics - major variables have been so apparent that they have received little experimental substantiation (p. 340)

   1. adults more efficient than children
   2. single sex groups more efficient than mixed
   3. men and women do better in their cultural roles
   4. groups composed of friends more productive than strangers
   5. duration of membership positively related to productivity

7.	cohesiveness	- cohesive groups tend to work harder regardless of outside supervision (p. 340)
		- cohesive groups will be especially productive if motivated to do the task well, e.g., B-29 crews (p. 340)
8.	group size	- principle of least group size (Thelan, 1949). Diminishing returns found in both physical and intellectual tasks when group includes excess number of people (p. 341)
9.	task (complicated vs. simple organization)	- complicated group organization for a difficult task performed under stress less likely to be highly productive than if there is ample time for a simple task with a simple organization (p. 342)
	definition of the situation	- the major effects of changes in task are found in the definition of the situation. If it is clear that work is the object, more group productivity is achieved if

	individuals do not spend too much time on individual goals, and are isolated from outside distraction (p. 342)
laboratory vs. field performance	- laboratory performance better than field because of less emotionality
effect of role definition	- work is facilitated if there is a clear set of roles which are appropriate to the task and are enforced
coordination	- with a task which requires complex problem solving or actual production of material, coordination, usually in the form of leadership, is especially important
	- unless members expected someone to be especially knowledgeable, they reacted negatively to the informed person (p. 342)
	- if the person has an obvious ability to find the right answer, the group will follow his lead

10.	Communication network	- regardless of the characteristics of the individual members, a number of changes can be made in the communication network which will increase productivity: 1. feedback from receiver to sender of messages 2. usually increased participation (discussion) is associated with increased member satisfaction 3. *if newcomers join a* group, there is a tendency for short-run decline in performance while the group reorganizes itself (Trow, 1960) 4. groups which have the fewest communication links between the point at which information is received and the point at which a decision is made should be the most efficient (Roby and Lanzetta, 1956) 5. the mode of communication will create differences in a group's

		ability to communicate which may disappear in the long run (p. 344)
11.	leadership	- studies of organizational effectiveness typically report that good leadership is a primary criterion for efficiency
		- although there is a tendency for groups led by autocratic leaders to produce more but of lower quality than groups led by democratic leaders, there is always high productivity where a skilled leader is playing the leader role (p. 344)
		- when leadership functions are shared rather than centered in one person, then productivity is increased if role differentiation has taken place (p. 344)
12.	majority rule vs. consensus	- laboratory studies report that groups produce decisions of higher quality

with less emphasis on personal orientations than do groups using a majority rule (p. 345)

- when a group must select from among a number of alternatives of which only one is correct, majority rule will give more reliable decisions in that the decision will be correct more of the time (Smoke and Zajonc, 1962) (p. 345)

13. decision rules

- observations of groups reaching decisions suggest that group decision behavior is a combination of an individual decision process plus a conflict-resolving process when members do not agree (p. 345)

- variations of decision rules include:

  1. "truth wins"
  2. majority rule
  3. consensus

- all groups tend to have implicit rules which govern

the decision-making process (Dulong, 1972) (p. 345)

- comparing the decision schemes of majority, plurality, equiprobability and the highest expected value, they found that the "equiprobability" scheme gave the best fit with their data. In this scheme, each strategy advocated by a member during a discussion has an equal probability of being selected (p. 345)

- another study suggests that members try to reach a decision which is "fair" in that most persons in the group reach their own level of aspiration as a result of the decision

- another study found that the best fit with actual data is obtained with a very simple model which assumes that the group decision is most often the median of the individual decision (Hare, 1970) (p. 346)

14. training and feedback - one of clearest findings in the small group literature is that group productivity will be improved if training is provided for members, no matter what the task (p. 354)

feelings of inferiority - persons who believe their skills are inferior to those of the others in the group are less likely to use the skills they have

feedback and involvement - when feedback is provided, group members tend to work harder, especially if they are evaluated by an expert and become more involved

feedback by TV - although subjects look to human observers for evaluation, feedback without comment from a TV camera can be equally effective

individual vs. group feedback - feedback provided on an individual basis has been found to be more effective than group feedback, probably because it can give the individual member a clearer idea of how to change his performance (p. 355)

type of reinforcement - the type of reinforcement or feedback also makes a difference. Negative feedback can be stressful (p. 355)

level of aspiration - if group members fail to meet their level of aspiration, they may try harder or they may not (p. 355)

failure levels - moderate levels of failure produced a greater effort to organize the group than did either low or high failure levels (p. 355)

feedback preference - members of groups prefer positive feedback and are more willing to believe it (p. 355)

success belief - members who believe they are successful, even though they may not be, will try to exert more influence (p. 355)

As previously noted in section 3.2, Zander (1971, pp.171-203) summarized the research on group motives first in terms of six topical headings with four kinds of results under each heading, and secondly in terms of the variables involved and the events which follow from the presence of each. The latter organization of information was provided to assist those interested in applied problems, and a summary in this format follows:

1. feedback on performance of group - when feedback is available:
    1. quality of the group's productivity improves for simple and complex tasks (those requiring considerable interaction)
    2. improvement in quality increases as the completeness of the feedback increases, i.e., feedback on the score of the group as a whole and on each individual member is more effective than either of these
    3. performance of individuals who have a stronger need to achieve success is more enhanced by fuller feedback

4. members make a more accurate evaluation of their group's performance because the information allows them to establish a more appropriate criterion for appraising events in the group

2. influence on group from external sources

- if an observer has information about the group's performance, he is likely to prefer the same aspiration for the group as the members do

- the level of performance an external agent suggests (intentionally and otherwise) does not have as much influence on a group's aspiration as does the suitability of the suggestion in the light of member's experience; social pressures from outside are apparently more influential if they emphasize the repulsiveness of failure than if they stress the attractiveness of success

- members will support one another in avoiding or derogating a task from an external source that is too difficult for them, provided they can do this without fear of repulsion from that source

- arousing an awareness of the undesirability of failure creates conforming behavior, but simultaneously induces a tendency to avoid the task and to use private criteria in judging the group's success

3. difficulty of task

- a harder (challenging) group task is more attractive than an easier one, and certain events occur

  1. participants are more interested in what they are doing
  2. they produce more
  3. they have more favorable feelings
  4. they evaluate the group's performance better

- an easier task is less attractive than a harder one

    1. members are less enthusastic about the work to be done
    2. produce less
    3. are more derogatory toward the group
    4. evaluate the group's performance less favorably

4. success versus failure

- after repeated successes group members:

    1. perceive that future promises a greater likelihood of sources at that level of difficulty
    2. raise their anticipated level of aspiration
    3. develop feelings of success and pride in the group
    4. assign a favorable evaluation to their group's performance
    5. attribute greater value to future success
    6. develop a disposition to seek future success
    7. perceive their group to be an attractive one
    8. become committed to the process of setting goals

- after repeated failure:

  1. members are less inclined to be concerned about the probabilities of future failure, or success

  2. instead, they seek means that will help them to avoid the unfavorable consequences of failure

- they tend to:

  1. lower the group's goal or stick with one they have failed to reach

  2. give an unapproving evaluation to their group's performance

  3. see the activity as less important

  4. believe the success on the task is less desirable

  5. are less attracted to their own group

  6. would like to judge the group in relation to its past performance than its goal attainment - they would gladly abandon altogether the practice of setting aspiration levels

5. desire for achievement of group success – a number of conditions arouse a desire that one's group attain the pleasing side effects of success:

   1. the group sets an aspiration level for a series of trials

   2. the group is successful

   3. the member perceives he has a responsibility for or a commitment to the group

   - if and when members develop a stronger desire for achievement of group success, a number of events regularly occur:

   1. members are cautious in setting aspiration levels

   2. members perform better

   3. have more favorable attitudes toward the group and its task

4. perceive that the product of the group depends upon their own effort

5. set their personal goals in accord with those proposed for them by colleagues

6. evaluate their personal performance in accord with the score obtained by the group

7. and support one another in the belief that achievement of success is important

Members also develop a desire to avoid unfavorable consequences that follow a failing performance by their group.

When the desire to avoid has been induced in members, they tend to favor unreasonably difficult goals and to act in ways earlier described for persons whose group has failed.

6. individual motives - for achievement — the challenge of working in a group arouses desire for personal success or avoidance of failure

   1. when feedback is group performance-oriented, personal motive causes most direct concern with selecting a challenging but not too difficult task

   2. when feedback includes his own output, as well as the group, he is more concerned with his compative position and is primarily interested in the achievement of individual excellence. If the choice is available, he will prefer to work for himself rather than the group

   3. those members who seek to avoid the by-products of failure try to be helpful and work hard when it becomes evident it is necessary. When placed in a central position, they tend to act like a person with a motivation to succeed

7. competence of member - a member who has objective evidence that he is more competent than the others, develops a greater interest in the fate of the group and works harder for its success than does a less competent member

8. centrality of position - one in a central position:

   1. is aware of his greater responsibility for the outcome of the group
   2. has a stronger desire for the group to be successful
   3. prefers moderately challenging goals for the unit
   4. develops greater tension when working for the group
   5. works harder
   6. produces more
   7. evaluates his own output in accord with the quality of the group's performance

   - central position person's reactions are stronger if his role is important in the flow of work than if he has the power to determine the group's aspiration level

9. sources of better group performance - better proformance occurs if a number of things happen:

   1. members are aroused to have a strong desire for group success
   2. each new goal is placed moderately higher than the past level of successful performance
   3. members are made aware that the group needs each person's best effort
   4. feedback is provided on the score of the group as well as the scores of individual members

The effect of this successful performance gives rise according to Zander to several useful properties in a group. These include:

1. awareness of accomplishment.
2. feelings of satisfaction.
3. stronger desire for success.
4. groups work harder.
5. coordinate their efforts more effectively.
6. less strain on interpersonal relations.
7. more attracted to membership.
8. group becomes more productive.

Bowen and Siegel (1973) investigated several of Zander's findings using M.B.A. students organized into four-person and two-person groups reviewing papers by each group. The following results were obtained:

1. confirmed the finding that perceived group effectiveness occurs over time.

2. confirmed that own role satisfaction and own part in group satisfaction increase over time.

3. confirmed that motivation increased over time.

4. found that group attractiveness increased over time whereas Zander found no difference.

5. found positive correlation between perceived group performance and personal involvement as simultaneous action whereas found that hypothetical performance leads to later involvement.

6. found that group attractiveness correlated with perceived group performance; Zander found no significance.

As previously noted in this report (pp. 3-39/3-44), Hackman and Morris (1975, p. 46) take the position that the key to understanding the group effectiveness problem is to be found in the ongoing interaction process which takes place among group members while they are performing a task. Accordingly the findings abstracted from Hackman and Morris discussed below emphasize input-process-performance relationships:

1. patterns of interaction - interactions can result in "assembly effect bonuses," i.e., patterns of interactions developed to produce better outcomes, (Collins and Guetzkow 1964) (p. 48)

2. interpersonal training activities - interpersonal training activities can powerfully affect both the nature of the interaction process in groups and the quality of members' personal experiences. But the few studies that have tested the effects of such changes on actual task performance have yielded ambiguous or negative results (see reviews by Harold 1974, Kaplan 1973) (p. 48)

3. input-process relationships - factors shown to affect group interaction include:

1. leader attitudes
2. member personality characteristics
3. group size
4. group structure
5. group history or experience (p. 51)

	task-process relationships	- almost every study that addressed the question unearthed substantial task-process relationships (p. 51)
4.	process-performance relationships	- little research conducted relating measured characteristics of group process to performance outcomes (p. 51)
	valence model	- inferential support available for the valence model of process-output relationships (p. 52)
	measures of group interaction	- measures of group interaction predict task success better than did measures of members' task-relevant knowledge or various task training procedures (p. 52)

5. input-process-performance relationships (group process) - substantial variation in group performance on intellective tasks is controlled by the nature of the group interaction process (p. 54)

substance of i-p-p relationships - little is known about the substance of the input-process-performance relationships (p. 56)

cultural norms - typically the norms that guide individual behavior in groups tend to be rather "conservative," that is they minimize the chances that members will have to deal with uncomfortable or anxiety-arousing behavior within the group (p. 60)

social interaction - can significantly affect how much effort member chooses to expend on a group task, and that the level of effort can easily change over time as the characteristics of the group interaction change (p. 64)

task performance strategies - at least in some cases group members are both capable and desirous of implementing

	implicity-agreed upon performance strategies without explicit discussion of what they are doing (p. 66)
	- there appears to be a pervasive norm in groups not to address the matter of reformulating strategies explicitly (p. 67). Overriding these norms may be a useful way to improve group performance effectiveness (p. 68)
group talent enhancing	- some evidence, e.g., from "training group" studies, suggests that group interaction can result in new knowledge and skill which did not previously exist within the group (p. 71)

Tables 3 and 4 contain

stantive variables included in Section 4.0 of this report.

In some instances, the findings are presented with topical headings used by the author, e.g., Zander. Similarly, e.g., McGrath and Altman (1966) who reported 59 simple and 6 complex substantive variables, the findings selected are included within categories these authors chose for developing operationally useful generalizations. In a very few instances, some duplication of information contained in discussions of theoretical and methodological developments earlier in the report will be noted.

Consideration was given in planning the research to employing methodology referred to as conceptual variable analysis, middle range theory building, or, what is now called, propositional inventory development. This could not be accomplished in those terms but the findings as collated can be further analyzed and propositions developed. In addition, the findings were collected within a theory-methodology-findings framework, and interpretations and conclusions within that total framework are the subject of interest, particularly with regard to the identification of opportunities for application to team training and performance improvement.

In this context, several examples of concepts which emanate from this collation of findings are: (1) enhancing group performance depends heavily upon the adequacy with which

Tables 3 and 4 contain a summary listing of the substantive variables included in Section 4.0 of this report. In some instances, the findings are presented with topical headings used by the author, e.g., Zander. Similarly, e.g., McGrath and Altman (1966) who reported 59 simple and 6 complex substantive variables, the findings selected are included within categories these authors chose for developing operationally useful generalizations. In a very few instances, some duplication of information contained in discussions of theoretical and methodological developments earlier in the report will be noted.

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In this context, several examples of concepts which emanate from this collation of findings are: (1) enhancing group performance depends heavily upon the adequacy with which

group interaction is understood, measured and trained for, (2) team tasks in military environments vary along several technical and social dimensions and team training needs to be responsive to these task requirements in terms which are appropriate to whatever task-contingent combinations exist in real-world situations, (3) team training and team performance strategies need to include consideration of a large number of input-process-performance variables and relationships, (4) consideration must be given to distinctions between individual and group goals, how the latter are set, how alternative goals are selected by groups, and how compatibility-incompatibility between individual and group goals is dealt with, (5) a hedonistic philosophy associated with individual performance appears to be replaced or augmented by altruistic commitment to the group, (6) integration processes for combining individual members' contributions to team performance have been identified, and (7) strategies for developing team performance and performance criteria need to recognize that developmental processes are operating both for the individual and the team and continuous attention to the dynamics of the totality of the situation is necessary to understand, achieve and maintain desired levels of team performance.

TABLE 3 - SUMMARY LISTING OF SUBSTANTIVE VARIABLES (TRAINING)* INCLUDED IN SECTION 4.0

Chapman et al. (1959)	Glanger (1962)	Klaus & Glaster (1968, 1970)
1. organizational goal	1. interactions	1. reinforcement of team responses
2. team skills	2. centralization	2. team acquisition and extinction
3. feedback	3. overloading	3. decrements in parallel teams
4. load	4. coordination	4. team arrangement
5. stress	5. extra-team input	5. team composition and membership
		6. supplementary reinforcement
		7. team environment simulation

Meister (1976)	Wagner et al (1975)
1. team learning	1. prior motivational states
2. individual vs. team learning	2. team awareness
3. fidelity of training	3. interpersonal skills
4. feedback-knowledge of results	4. low fidelity simulation
5. task complexity	5. team structure and composition
6. reinforcement	
7. training flexibility	

*See also Table 2, p. 4-3 (Briggs & Johnston 1967)

TABLE 4 - SUMMARY LISTING OF SUBSTANTIVE VARIABLES (SMALL GROUP BEHAVIOR) INCLUDED IN SECTION 4.0

Meister (1976)	Davis (1969)	Helmreich et al (1973)
1. group vs. individual performance	1. group size	1. social facilitation
2. small vs. large groups	2. eye contact	2. task performance
3. monitors	3. group composition	3. risky shift
4. organizational size	4. intellective abilities and performance	
5. crew composition	5. personality traits of group members	
6. member replacement	6. group cohesiveness	
7. performance variance	7. effects of cohesiveness on performance	
8. team organization	8. effects of performance on cohesiveness	
9. indeterminate organizations	9. cooperation and competition	
10. team organization	10. norms	
11. division of labor		
12. procedural flexibility		
13. interaction		
14. independence/load balancing		
15. redundant personnel		
16. feedback		
17. communications		
18. communication channel		
19. communication structure		
20. communications pattern		
21. motivation		

TABLE 4a- SUMMARY LISTING OF SUBSTANTIVE VARIABLES (SMALL GROUP BEHAVIOR) INCLUDED IN SECTION 4.0

Hare (1976)

Superiority of the Group:

1. manual vs. intellectual tasks
2. individual superiority conditions
3. standards of productivity
4. accuracy of reporting
5. accuracy of judgment
6. "risky shift"

Group vs. Group:

1. general characteristics of productive groups
   - step following
   - structure - morale
   - attitudes
   - group organization
2. criteria for productivity
   - laboratory vs. field
   - crew effectiveness
3. satisfaction vs. productivity
   - intermember relationships
   - competition vs. cooperation
   - authoritarian leaders
   - self-oriented needs
   - interpersonal conflict
4. members personalities
   - members' characteristics
   - patterns of interaction
   - leaders personalities
5. compatibility of affectional orientation
6. social characteristics
7. cohesiveness
8. group size
9. task
   - complicated-simple organization
   - definition of situations
   - laboratory vs. field performance
   - role definition
   - coordination
10. work communication network
11. leadership
12. majority rule vs. consensus
13. decision rules
14. training and feedback
    - feelings of inferiority
    - feedback and involvement
    - feedback by TV
    - individual vs. group feedback
    - type of reinforcement
    - level of aspiration
    - failure levels
    - feedback preference
    - success belief

TABLE 4b- SUMMARY LISTING OF SUBSTANTIVE VARIABLES (SMALL GROUP BEHAVIOR) INCLUDED IN SECTION 4.0

Davis (1973)

Cooperative interaction - Group Problem Solving:

1. ability
2. reinforcement contingencies
3. group organization
4. individual vs. group performance
5. interpersonal learning
6. motivational

Cooperative interaction - Group Decision Making:

1. group composition
2. group size
3. social process factors

Steiner (1972)

1. group performance:
   - unitary tasks
   - divisible tasks
2. group size
3. consequences of group composition
   - heterogeneity of resources
   - heterogeneity of disposition qualities
4. motivation
5. payoff systems

McGrath & Altman (1966)

1. characteristics of group members
   - abilities
   - experiences
   - personality
     - biographical
   - member attitudes
   - authoritarian attitudes
   - member position
2. characteristics of the group
   - capabilities
   - experiences
   - size
   - composition
3. interpersonal relations
4. leadership
5. task performance of group members
   - member characteristics role
   - environmental factors role
6. task performance of the group
   - member characteristics role
   - group characteristics role
   - environmental factors
7. personality and social factors

TABLE 4c - SUMMARY LISTING OF SUBSTANTIVE VARIABLES (SMALL GROUP BEHAVIOR) INCLUDED IN SECTION 4.0

Zander (1971)	Bowen & Siegel (1973)	Hackman & Morris (1975)
1. feedback on performance of group	1. perceived group effectiveness	1. patterns of interaction
2. influence on group from external sources	2. own role and group satisfaction	2. interpersonal training activities
3. difficulty of task	3. motivation	3. input-process relationships
4. success vs. failure	4. group attractiveness	4. process-performance relationships
5. desire for achievement of success	5. perceived group performance	valence model
6. individual motives and achievement	6. group attractiveness and perceived group performance	measures of group interaction
7. competence of member		5. input-process - performance relationships
8. centrality of position		group process
9. sources of better group performance		L-p-p relation ships
		cultural norms
		social interaction
		task performance strategies

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of this research was to review selectively the literature on small group behavior to identify scientific and technical advances potentially applicable to the development of an improved team training technology. Specific objectives included conducting a state-of-the-art assessment in both areas in terms of theories, methods and techniques, and findings on substantive variables; identifying specific small group behavior research contributions potentially useful in developing a strategy for establishing team, team training and team performance requirements; and preparing research program recommendations for capitalizing on small group behavior research advances supportive of team training technology needs.

The review of the team training research and operational literature was comprehensive, and the results indicate not only that team training technology is underdeveloped but also that few advances have been made during the past ten years because of limited research and development funding. Specific deficiencies include but are not limited to:

1. the absence of a theory of teams as units including a set of defining variables and supporting empirical data bases
2. population data on teams and related sampling designs

3. analytical techniques and criteria for the study of teams, team training and team performance

4. assessment, evaluation and feedback systems for use by operational units and team training organizations

5. an Instructional System Development model designed to meet team training requirements

6. a narrow data base of substantive findings on Navy warfare or platform level training requirements

7. absence of team training guidelines for use in the design of large, complex team training devices

The selective review and analysis of the small group behavior literature emphasized substantive areas which might contribute new concepts for the team, analytical techniques for studying teams as dynamic units in which interactions and situational factors are important elements, and methods and techniques for the measurement and enhancement of team performance within an input-process-output paradigm. Particular attention was given to research related to theories of groups, experiential learning, group motives and goals, group performance and productivity, group growth and development, and group interaction analysis. The general trends noted in the literature were: (1) the increasing volume of research publications, (2) progress in but concerns about the quality of research and the failure to integrate theoretical and empirical research, and (3) the continuing emphasis on such research topics as conformity, interpersonal choice,

social perception, interaction process and leadership with little attention to roles, personality, social characteristics, group size and group productivity.

5.2 Conclusions

Major conclusions from this research are:

1. as a result of limited support for theoretical and empirical research in team training and performance, numerous gaps exist at both the scientific and technology levels

2. little progress toward the goal of developing a comprehensive technology relating to teams, team training and team performance can be expected under presently planned research and development programs related to teams

3. Navy operational and training commands have documented their needs for improvements in team training and performance particularly with regard to issues such as the need for operational definitions of a team, the development of new educational technology, deficiencies in analytical techniques and criteria for determining team training requirements and measuring team training effectiveness and performance, and the need for new guidelines for use in the design of training systems and devices

4. utilization of theoretical and methodological developments and findings on a large number of substantive variables from small group behavior research would facilitate the development of an improved technology of team training and team performance

5. development of an Instructional System Development (ISD) model assigned specifically for team requirements is possible and would significantly enhance team training efficiency and effectiveness

6. new programs of team research and development will need to employ strategies, e.g., the use of technical advisory groups, for maximizing

the use of the limited amount of expertise presently available while developing a larger national capability interested and competent in team/group research

5.3 Recommendations

The review of the literature revealed areas of concerns which involve Navy operational requirements for improvements in team training, RDT&E policy relating to priorities and funding for team training technology development, and scientific and technical requirements. The recommendations which follow assume that the operational requirements are valid, and that RDT&E policies of support will be consistent with the importance and criticality of these requirements.

It is recommended that:

1. identified scientific and technical advances from small group behavior research be utilized in planning and implementing team training research and development programs as timely opportunities for making significant improvements in team training technology

2. research and development strategies recognize the importance of both laboratory and field settings as essential and complementary in developing and utilizing team training technology

3. concepts of growth and development of teams as units in addition to growth and development of individuals, together with interaction analysis methods, team task typologies, and an input-process-output paradigm become essential technical elements of team training research methodology

4. team training and team performance be recognized as highly complex areas requiring support from a number of disciplines, and that multi-disciplinary capabilities be brought to bear in planning and implementing supporting research and development

5. mechanisms be established for exchanging scientific and technical information relating to team and team research and development problems and opportunities on a continuing basis

6. additional research efforts be supported to investigate other small group behavior research developments beyond those included in this research for possible application to team training needs

7. further analysis be conducted on the large number of findings on substantive variables contained in this report with a view toward developing an inventory of propositions to fill gaps in team training technology bases

8. an Instructional System Development (ISD) model for team training requirements in various warfare areas be developed beginning with surface warfare and support systems

9. a prototype model of team growth and development be developed incorporating concepts and strategies associated with relevant research on small group behavior, particularly group interaction analysis, group productivity, and group motives and goals

10. a broad-based program of team performance research be initiated centered in the laboratory setting to provide fundamental, mission-oriented concepts, principles and data which must be available before progress can be made in developing a team performance technology

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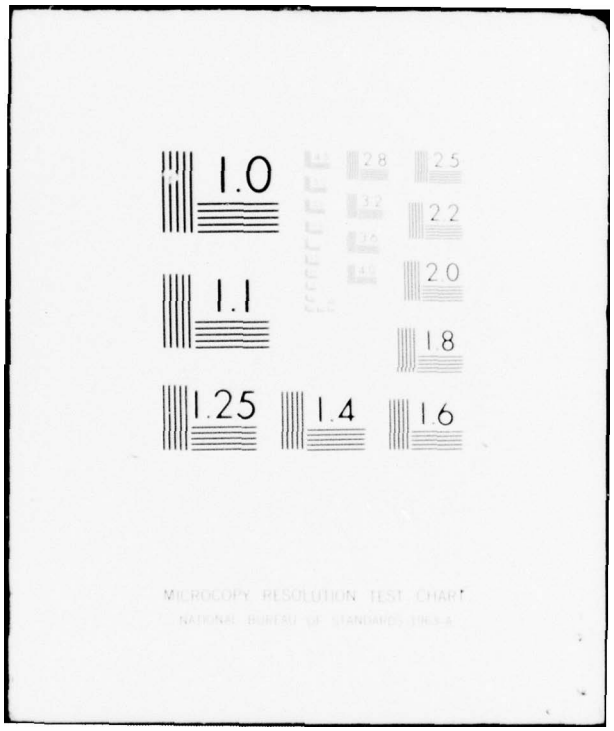
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The authors utilize the characteristics of computerized command control systems to derive common training objectives and to delineate several system training problems. Theoretical approaches and models of team training are discussed, e.g., organismic and stimulus-response. Previous research on team training is organized in terms of task environment, knowledge of results and exercising variables. A team training research program is outlined oriented toward "a most important and neglected research problem...how teams learn to respond effectively in unusual, undeterminate, or high load situations."

Alexander, L. T., Kepner, C. H. and Tregoe, B. B. The effectiveness of knowledge of results in a military system-training program. Journal of Applied Psychology, 1962, 46, 202-211.

An experiment to investigate the effects of knowledge of results (KR) on performance improvement of a man-machine, information-processing system. Four 13-man crews were given a pretest exercise, then 12 training exercises, then a posttest exercise in air defense operations using their own operational equipment and a simulated air environment. Two experimental crews received KR at a postexercise debriefing; two control crews received no KR or debriefing. The experimental crews improved more than the control crews in all but one (tactical action) function but improvement across functions was not equivalent.

Altman, Irwin and Terauds, Anita. Major variables of the small group field. AFOSR-TN 60-1207 (ASTIA AD NO. 250 740). Arlington, Virginia: Human Sciences Research Inc., November 1960.

This report reviews major and minor variables of the small group field. The review includes descriptions of variable subclasses, information about rates of appearance, and results of each variable's association with other variables. A special review of individual and group performance effectiveness variables is presented.

Bales, R. F. Interaction process analysis: A method for the study of small groups. Reading, Mass.: Addison-Wesley Press, 1950

A comprehensive report on the development of a category system for interaction observation. Exploratory hypotheses about the characteristics of interaction are presented, as well as preliminary data on cumulative norms for the observation system. The theoretical nature of social interaction is considered in terms of the objectives of small group experimentation.

Bennis, W. G. and Shepard, H. A. A theory of group development. In Gibbard, G. S. et al. (Eds.). Analysis of Groups. San Francisco, California: Jossey-Bass Publishers, 1974, 127-153.

The authors present a theory of group development based for the most part on observations made over a five-year period of teaching graduate students "group dynamics." The theory is applicable to groups that have as their goal improvement of their internal communications system. The core of the theory is that the principal obstacles to development are to be found in the orientations toward authority and intimacy that members bring to the group. Development involves movement from preoccupation with authority relations to preoccupation with personal relations. A two phase, each with three subphases, process is described.

Berkowitz, L. and Levy, B. Pride in group performance and group-task motivation. Journal of Abnormal Soc. Psychology, 1956, 53, 300-306.

These authors investigated the relationship between KOR and motivation toward the group task using a simulated air defense task, favorable/unfavorable feedback, and individual/team performance KOR. When teams received favorable evaluations, their motivation toward the task increased, as measured by a greater amount of task-oriented discussion during work period breaks. Highest motivation was associated with group rather than individual KOR. The authors concluded that team members are interdependent in attaining reward and this produces high motivation.

Birkett, B., Zagorski, H., Grace, G. and Murphy, B. NORM briefing guide. TM-(L)-3212-000-01. Santa Monica, California: System Development Corporation, 5 January 1968.

This package of materials was prepared for briefing military personnel regarding the NORM computer program which was designed to provide an automatic evaluation of a Sage crew during an automated system training mission (ASTM). The package contains textual material and a set of slides.

Boguslaw, Robert and Porter, Elias H. Team functions and training. In Gagné, Robert M. (Ed.). Psychological principles in system development. New York: Holt, Rinehart and Winston, 1962, 387-416.

Reviews the concept and meaning of teams and team training, major programs of team training research and technologies, design of training systems, and provides a research perceptive. A distinction between established and emergent functions of teams is made and the implications for research enumerated.

Bowen, D. D. and Siegel, J. P. Process and performance: A longitudinal study of the reactions of small task groups to periods performance feedback. Human Relations, 1973, 26, 433-448.

Study involved 86 M.B.A. students (85 males and 1 female) divided into 20 four-person and 2 three-person groups and measures of group performance on five 5-7 page papers by each group and questionnaire. Purpose of study was to replicate Zander's findings (1971). Findings confirmed on perceived group effectiveness, own role satisfaction and own part in group satisfaction, and motivation increases over time. Contradicting findings found regarding group effectiveness, perceived group performance and personal involvement, and group attractiveness.

Bowser, Samuel E. Determination of criteria of operational unit effectiveness in the U. S. Navy. TR 76TQ-41. San Diego, California: Navy Personnel Research and Development Center, August 1976.

The criteria for evaluating organizational effectiveness are considered within a system framework. A general review of the literature is presented. Operational unit management personnel were interviewed and this interview material was content analyzed. The resulting content categories were cross compared by unit type, position in the organization, rank of respondent and question answered. The results show military managers to be performance oriented and supportive of objective type criteria for evaluations. (Author)

Branson, Robert K., Rayner, Gail T., Cox, J. Lamarr, Furman, John P., King, F. J. and Hannum, Wallace H. Interservice procedures for instructional systems development: Executive summary, phase I, phase II, phase III, phase IV, and phase V. Tallahassee, Florida: Center for Educational Technology, Florida State University, August 1975.

This report is a five volume set of procedures developed for the preparation of curriculum for interservice training. The procedures address five major phases, which are: analyze, design, develop, implement, and control. The procedures begin with methodology for conducting a job analysis for the curriculum subject area for which the instruction is to be developed and goes through 18 additional steps suitable for the empirical development of interservice training.

Briggs, G. E. and Johnston, W. A. Team training. Technical Report 1327-4. Orlando, Florida: Naval Training Device Center, June 1967.

This is the final report on a four-year (1964-1967) contract program of laboratory research at the Ohio State University on team training in a combat intelligence center context. The research literature on team training is reviewed and a set of conclusions is drawn with regard to team performance as a function of task, training, and communication variables. The implications of this research are presented with regard to a specific team training device. The appendices contain full descriptions of three laboratory studies not reported previously in the literature.

Campbell, John P. Personnel training and development. In Mussen, Paul H. and Rosenzweig, Mark R. (Eds.). Annual Review of Psychology, Palo Alto, California: Annual Reviews Inc., 1971, 22, 565-602.

This first review of the personnel training and development areas covered 3-5 years prior to 1971 for primary reference sources. Noting that "by and large, the training and development literature is voluminous, nonempirical, nontheoretical, poorly written, and dull," Campbell discusses models, theories and the training problem; new developments in technique; evaluation methodology; empirical research; and concluding remarks which cite internal and external reasons why the field has not realized its potential.

Carson, R. C. Interaction concepts of personality. Chicago: Aldine, 1969, 93-171.

In his analysis of varieties of interpersonal behavior, Carson reviews the work of Roger Brown, Borgatta, Cottrell and Mann, Lorr and McNair, and most particularly Timothy Leary in the field of interpersonal behavior. He identifies a set of categories of social behavior and indicates that for each category there seems to be an identifiable and finite range of complementary behaviors, resulting in a "reward" or "cost" for the individuals involved. In discussing negotiating interpersonal transactions, Carson further analyzes theories of interpersonal relations building upon the work of Thibaut and Kelley, and Homans. He examines the exchange view of such interaction as a bargaining relationship where hedonistic outcome is calculated in terms of rewards, cost, and a concept of net magnitude (rewards minus costs).

Cartwright, D. and Zander, A. (Eds.). Group dynamics research and theory. New York: Harper & Row, 1968.

This book is divided into seven parts as a revision to previous editions to provide a systematic summary of a growing body of research. This third edition contains the same structures as previous editions but the substance of the book reflects reports of recent efforts to subject early work to the test of a replication and extension to new types of population or situation. Theoretical and social origins of group dynamics, theoretical and methodological approaches and issues, a large body of empirical findings, principles and needs are included.

Chesler, David J. Computer-assisted performance evaluation for Navy anti-air warfare training: Concepts, methods and constraints. Research Report SRR 71-25, San Diego, California: Navy Personnel and Training Research Laboratory, May 1971.

Report formulates a general methodological approach for advanced development of computer-assisted evaluation of trainee performance in the computer-based simulation environment, i.e., Navy Tactical Advanced Combat Direction and Electronic Warfare (TACDEW) system. A six-step performance evaluation development methodology is presented together with a review of pertinent performance research.

Chesler, David J. Application and utilization of training aids and devices: Simulated exercises and trainee performance evaluation. Research Report SRR73-7, San Diego, California: Navy Personnel and Training Research Laboratory, September 1972.

This final report of Navy advanced development project, "Application and Utilization of Training Aids and Devices: Simulated Team Exercises-Performance Evaluation," summarizes the conceptual model, nine-step exercise design and six-step performance evaluation methodology developed and applied in formulating performance data requirements. Various operational and administrative constraints in conducting this kind of demonstration are enumerated.

Chow, Esther Ngon Ling-Ester and Billings, Carmela. An experimental study of the effects of style of supervision and group size on productivity. Pacific Sociological Review, 1972, 15(1), 61-82.

This experiment involved small groups (3's and 4's) of female college students assembling molecular models. The findings supported the hypotheses that: (1) personal supervision improves productivity; (2) personal supervisor should be more likeable than impersonal one; and (3) the size-of-group variable was found to be operative.

Collins, Barry E. and Raven, Bertram H. Group structure: Attraction, coalitions, communication, and power. In Lindzey, Gardner and Aronson, Elliot (Eds.). The handbook of social psychology. Reading, Massachusetts: Addison-Wesley Publishing Company, 1969, 4, 102-204.

The authors provide a comprehensive review and assessment of the psychological aspects of group structure theory, models, dimensions, variables, empirical investigations, focusing on interpersonal attraction, coalitions, communication nets, and power. The problems of classification, organization and coding of the large number of items in the literature were not fully resolved and the need for a system of classification is emphasized.

Cooper, Cary L. (Ed.). Theories of group processes. London: John Wiley & Sons, 1975.

Contains ten articles on the social and psychological problems of the interrelationship between the individual, the various groups of which he is a member, and the organizational environment within which he and his groups function. The focus of the book is on theory building in the understanding of these processes for large and small groups, with particular reference to experimental group processes. Substantive areas include learning environments, experiential learning, intensive groups, consciousness-raising, team building, interpersonal trust, sensitivity training, leadership, equality in groups.

Copperman, Norman and Dorian, Paul Asa. Using CAI to measure team readiness. Orlando, Florida: Proceedings of Ninth NTEC/Industry Conference, "Readiness Through Simulation," 9-11 November 1976.

The authors describe the first phase of a two phase program to improve Anti-Submarine Warfare team training. Phase I involves the development and evaluation of a scoring system based upon objective criteria for evaluating ASW team performance. Phase II will include development of a variety of standardized, computer-based problem scenarios for use with the 14A2 training device.

Cummins, R. C. and King, D. C. The interaction of group size and task structure in an industrial organization. Personnel Psychology, 1973, 26, 87-94.

Studying first line supervisors and their groups in a manufacturing plant, groups ranging in size from 10-37 with an average of 21 were evaluated on high structured and low structured tasks. For high structure tasks, large groups have higher productivity and better relations. In low structure tasks, there was a non-significant but negative correlation between group size and productivity and relations.

Davis, James H. Group performance. Reading, Mass.: Addison-Wesley Publishing Company, 1969.

The organizing theme in this small book is the comparison of individuals with groups in various circumstances of performance. Davis' view is that the translation of individual task behavior into group performance is an important aim of social theory and research. The technical emphasis is on social interaction processes and social combination schemes (baselines) for translating member contributions to the task into a group product. Variables emphasized as affecting performance are categorized under group size, composition, cohesiveness and structure, the latter defined as a pattern of interpersonal relations.

Davis, James H. Group decision and social interaction: A theory of social decision schemes. Psychological Review, 80(2), 1973, 97-125.

This paper proposes a general theory for many kinds of group decision making and illustrates some special case models. While focusing on the traditional issue of individual-group differences, the theory is aimed at accounting for the distribution of group decisions by using formal hypotheses about the effects of social interaction when the inputs to discussion are individual member preferences.

Defense Documentation Center. Team training: A report bibliography. Alexandria, Virginia, December 1976.

This bibliography report on team training covered the period 1974-1976. A small number of projects is reported, a few of which are tangentially relevant to team training.

Defense Documentation Center. Team training: Work unit summaries. Alexandria, Virginia, 15 December 1976.

This tabulation of DoD Work Unit Summaries covered the period 1971-1976. Eighteen first level search terms and five second level terms related to training and group performance were used. The search identified few on-going or completed research efforts in team training.

Defense Science Board. Summary report of the task force on training technology. Washington, D. C.: Office of Director of Defense Research and Engineering, 22 February 1976.

Report contains findings, conclusions and recommendations of the Task Force studies conducted between July 1974 and June 1975. Report places considerable emphasis on the need for cost-effectiveness analyses of training, and the benefits or potential benefits that could accrue from the timely implementation of training technology research and development findings. Crew, group, team and unit training requirements are emphasized.

Eckstrand, Gordon A. Current status of the technology of training. Training Research Division, Behavioral Sciences Laboratory, Wright-Patterson Air Force Base, Ohio. Presentation at the 72nd APA Annual Convention, Los Angeles, California, September 4-9, 1964.

The author presents a brief overview of the status of the technology of training and indicates where further improvements would make major contributions to training efficiencies. The paper includes discussion of the general status of training technology; the processes involved in designing a training system presented in terms of determining training requirements, developing the training environment, and measuring the results of training; and enumeration of promising research areas. The conceptual orientation is on the systems approach to training.

Egerman, Karl. Effects of team arrangement on team performance. Journal of Personality and Social Psychology, May 1966, 3(5), 541-550.

Egerman studied two-man teams, the members of which were first trained individually, then as team members. He found that (1) preteam measures of individual proficiency entered into appropriate probability formulae provide accurate predictions of initial team performance;(2) feedback linkages were observed in each of the team arrangements; (3) feedback parameters were found to be related to the probability of feedback linkages; (4) reinforcement schedules depend on individual proficiencies and team assignment; (5) changes from initial to final team performance may be anticipated on the basis of reinforcement schedules.

Eityn, D. Stanley. The effect of group structure on the success of athletic teams. International Review of Sport Sociology, 1973, 8(1), 7-17.

Using questionnaires sent to coaches of high school basketball teams, the author found a moderate but consistent relationship between homogeneity of the group and the absence of cliques, and a definite relationship between the existence of cliques and winning percentages.

Erez, Miriam. Feedback: A necessary condition for the goal setting-performance relationship. Research Report No. 10. ONR Contract No.N00014-75-C-0884. College Park, Maryland: University of Maryland, 1976.

The study focused on feedback as a necessary condition for goals to affect performance and predicted that feedback and goals would be interactively related to performance. Also, it was suggested that the interaction of feedback and self goals be viewed as an individual x environment interaction model. Results supported the hypothesis that feedback would facilitate the display of individual differences in self-set goals and hence, the self-set goals-performance relationship. Individual differences in self-goals were significantly higher in the feedback group, than in the no feedback group, and in the feedback condition the relationship between goals and performance was significantly higher than in the no feedback.

Federico, Pat-Anthony. Computer simulation: A technique for studying psycho-social and sociotechnical systems. TN 76-3. San Diego, California: Navy Personnel Research and Development Center, January 1976.

From a comprehensive literature review the author concluded that computer simulation methodology can be used to overcome obstacles impeding man's understanding of, and scientific advancement in, psycho-social and sociotechnical systems. He views many investigations identified as demonstrating the feasibility of using simulation techniques to analyze and synthesize organizational systems. Finally the accrued advantages and potential payoffs resulting from using simulation techniques are viewed as far outweighing any pitfalls that may be encountered in their implementation.

Frank, Frederic and Anderson, Lynne R. Effects of task and group size upon group productivity and member satisfaction. Sociometry, 1971, 34(1), 135-149.

Comparisons were made among small groups of various sizes on conjunctive and disjunctive tasks in a test of Steiner's model for predicting the interaction of group size and task size. Results showed increases in group size enhanced quantitative performance on disjunctive tasks but were detrimental to performance on conjunctive tasks. A direct relationship was found between "pleasantness" and "enjoyment" of the tasks. Disjunctive tasks were found to produce more satisfaction, and odd-sized groups were generally more satisfied than even-sized groups.

Gagné, Robert M. (Ed.). Psychological principles in system development. New York: Holt, Rinehart and Winston, Inc., 1962.

This book is presented as the first of its kind, marking the coming of age of a "systematic conception of the application of psychological principles to the invention, development, and use of complex man-machine systems." Fourteen chapters cover a variety of topics discussed in terms of a theory of psychotechnology within a systems context.

Gibbard, G. S., Hartman, J. J. and Mann, R. D. (Eds.). Analysis of groups. San Francisco: Jossey-Bass, Inc., 1974, 1-12.

The authors examine the strategies of observation and analysis noting that small group research has concerned itself with two major issues: (1) development changes in group process and structure, and (2) the role of individual "leaders" or "role specialists" in dictating the direction of social change. They believe methodological strategies in small group research can be described as "clinical" (hedgehogs) and "statistical" (foxes), plus a third approach "hybrid" (hedgefoxes). Leading researchers are categorized and their approaches analyzed. The position is taken that the ultimate answer to questions of optimum methodologies and their use lies in the needs, values and particular questions of the individual researchers. The authors "have simply stated the alternatives."

Glanzer, Murray. Experimental study of team training and team functioning. In Glaser, Robert (Ed.) Training research and education. Pittsburgh: University of Pittsburgh Press, 1962, 379-407.

This chapter reports on a program of research on team training and reviews field investigations of team operation and experimental laboratory studies on the functioning of teams and small groups. The implications of these investigations for team training are discussed including several problems associated with training and research. The view presented is that research on team training procedures should investigate the reinforcement feedback conditions supplied to each team member as a function of team organization leading to the study of reinforcement contingencies that influence learning in the way they are studied in investigations of individual learning.

Glanzer, Murray and Glaser, Robert. Techniques for the study of group structure and behavior: Part I. Analysis of structure. Psychological Bulletin, September 1959, 56, 5.

The work on the structure of groups, with an emphasis on communication structure, was examined. Mathematical techniques growing out of sociometry are the focus. The authors point out that the techniques permit the analysis of a much wider variety of organizational relationships than hitherto studied, but in most cases they will probably be helpful only in clarifying the requirements for adequate descriptive or explanatory systems. They note that the task of constructing theories concerning the behavior of groups remains.

Glanzer, Murray and Glaser, Robert. Techniques for the study of group structure and behavior: Part II. Empirical studies of the effects of structure in small groups. Psychological Bulletin, January 1961, 58, 1.

This paper reviews laboratory studies in which experimenters imposed different communication structures on groups and measured the effect of the structures on performance. The authors trace the development of research on the effects of group structure beginning with Bavelas (1948) through to Rosenberg and Hall (1960). The authors note that "at the present time, there is still a major need for a system to order the data already obtained and to direct further work on the effects of group structure."

Greller, M. M. Process and effectiveness: A survey of small group research findings. Unpublished manuscript, New Haven, Conn.: Yale University, Department of Administrative Sciences, October 1972.

This paper points out several trends in the social psychology literature dealing with ways in which group processes may be influenced to effect productivity. Research on T-Groups, the "developmental leader," Roby's "executive function," laboratory education, and related works are discussed. Greller cites the "crying" need to abstract the essence from research in leader-based and process interventions to determine their utility and the character of the situations in which they are useful.

Hackman, J. R. and Kaplan, R. E. Interventions into group processes: An approach to improving the effectiveness of groups. Decision Sciences, 1974, 5, 459-480.

The authors examined process interventions involving changes in both group norms and actual behavior of group members using productivity tasks. Results obtained indicated that the interventions do change group behavior with demonstrable effects on group performance and members' experience. The authors point to the sterility of the test environment and the need for systematic research in the more complex environment of on-going organizations.

Hackman, J. R. and Morris, C. G. Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. Advances in Experimental Social Psychology, 1975, 8, 47-99.

Group effectiveness is seen to depend on interaction among the members of the group while they are working on a task. The authors attempt to identify, measure, and change the aspects of group interaction. Section I is a review of previous research. Section II is (1) a study of how group interaction enhances or depresses group effectiveness; (2) the formulation of strategies for influencing group interaction and group performance by alteration of "input" factors; and (3) a call for further research in understanding the factors that go into group effectiveness and how to improve it. Section III - The arguments for research are more fully developed and suggestions are made for action-oriented research in particular.

Hackman, J. Richard and Vidmar, Neil. Effects of size and task type on group performance and member reactions. Sociometry, 1970, 33(1), 37-54.

This study explored the effects of the size of the group and the type of task on the reaction of the members and on performance. Subjects were 35 students. It was found that dyads yield greatest satisfaction for the members and that dissatisfaction increases roughly with group size. Subjects found production tasks most difficult and stressful and problem solving tasks most relaxed. Contrary to expectation, no interaction was found between group size and task type in predicting behavior.

Haines, Donald B. Training for group interdependence. AMRL-TR-65-117. Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, January 1965.

Small teams and crews working together in intimate coordination are the key to many USAF missions today and effective team performance may depend upon member interdependency within the group. An adequate training program requires understanding of the ways in which men work together in closely-knit groups. Goal and means interdependency in group process has long been a focus of interest for social psychologists. Current research and theory thus may provide useful guidelines for applications of group interdependency principles to military crew situations (particularly that of the American military advisor working with his foreign counterpart). The concepts of goal and means interdependency are defined, the controversy between current exponents of cognitive and stimulus-response (S-R) theory is examined for its contribution to understanding group interdependency phenomena, the recent adaptation of the theory of games is reviewed, and suggestions are made for the development of experimental training programs which will furnish insights into the nature of group functioning. (Author)

Hall, R. L. Group performance under feedback that confounds responses of group members. Sociometry, 1957, 20, 297-305.

Using a task involving learning to turn a concealed knob a required number of turns during a timed interval, Hall investigated the performance of two man teams with KOR provided to each team member which was a single team score that combined the responses of both members. Pretraining under direct vs. confounded feedback and the relative weighting of the responses of the two subjects when feedback was confounded were the two experimental variables considered. Hall found that teams pretrained on confounded feedback improved their accuracy at a greater rate than teams trained on individual feedback. Error compensation by team members was put forth as accounting for the results.

Hall, E. R. and Rizzo, W. A. An assessment of U. S. Navy tactical team training. TAEG Report 18. Orlando, Florida: Navy Training Analysis and Evaluation Group, March 1975.

This study report compiled information for planning and development of improved team training practices, procedures and associated hardware, and for resource management in the U. S. Navy. Specific objectives of the study included: (1) describe and assess the status of team training, (2) review and critically evaluate findings in the technical literature regarding team training, and (3) develop and recommend potential solutions to team training problems.

Hall, Joy and Williams, Martha S. Group dynamics training and improved decision making. Journal of Applied Behavioral Science, 1970, 6(1), 39-68.

In an experiment testing the efficiency of laboratory training in group dynamics as a technique for modifying group processes toward theoretically more effective practices, data were analyzed on both process and performance criteria. Results indicated that trained groups consistently performed better than untrained groups on measures of decision quality, utilization of superior resources and creativity.

Hare, A. Paul. Bibliography of small group research: 1959-1969. Sociometry, 1972, 35, 1-150.

This bibliography covers the period 1959 through 1969 with a few items from 1970 and 1971. As the fourth bibliography by the author, the present listing concentrates on laboratory and field studies where observation was rigorously controlled. The categories in the index are the same as those used for organizing chapters in Hare's 1962 Handbook of Small Group Research. New categories were created for topics on which there was a significant increase in the amount of research such as social exchange, competition in two-person games, and the risky shift phenomenon.

Hare, A. Paul. Handbook of small group research. New York: The Free Press, 1976.

This revision of the 1962 handbook summarizes the major trends and findings in theory and research on small groups from 1898 through 1974 with more than 6,000 references. The book is organized in three parts: (1) interaction and group structure, (2) factors which can produce changes in group norms, the interaction process, the role system, and the pattern of interpersonal choice, and (3) a summary of the literature from the point of view of productivity. Four appendices provide information on small group experiments, the history of small group research, the most commonly-used research methods, and an overview of group dynamics in sensitivity training and related areas.

Hare, A. Paul, Borgatta, Edgar F. and Bales, Robert T. (Eds.). Small groups: Studies in social interaction. New York: Alfred A. Knopf, 1955.

This book is divided into four parts. Part I is concerned with historical and theoretical background of the field. Part 2 is a collection of studies which view the social process from the perspective of the single individual in a social situation. Part 3 contains studies focused on external observations of the group as a system of social interactions and describing its characteristics. Part 4 is an annotated bibliography of 580 titles.

Helmreich, Robert, Bakeman, Roger and Scherwitz, Larry. The study of small groups. In Mussen, Paul H. and Rosenzweig, Mark R. (Eds.), Annual Review of Psychology, Palo Alto, California: Annual Reviews Inc., 1973, 24, 337-354.

This review covers the period 1967-1972. The review includes sections on methodology, attraction, conformity and social influence, cooperation and competition, performance, social facilitation, task performance, risky shift, leadership, environmental psychology, encounter groups, and a postscript. The authors state "summarizing the research reviewed (or not reviewed) in an area as diverse and loosely linked as the study of small groups is a practical and theoretical impossibility."

Hewett, T. T., O'Brien, G. E. and Hornik, J. The effects of work organization, leadership style, and member compatibility upon the productivity of small groups working on a manipulative task. Organizational Behavior and Human Performance, 1974, 11, 283-301.

Defining collaboration (when members share responsibility for some tasks) and coordination (no overlap of tasks and definite precedence relations) and using a task of constructing molecular models, 96 undergraduates were divided into groups of three-persons, all-male or all-female. Group leaders had high or low LPC scores. Groups had high or low compatibility. Dependent variables were quantity and quality of models. Coacting groups (all work done individually) and coordination groups were most productive. Collaboration groups were least productive.

Hinton, W. M. and Fishburne, R. P., Jr. Performance oriented aircrew training: Optimization through ISD. Orlando, Florida: Proceedings of Ninth NTEC/ Industry Conference, "Readiness Through Simulation," 9-11 November 1976.

The authors describe their approach in employing traditional and modified Instructional System Development techniques to develop a training program for E-2C aircrew training with a greater emphasis on a "system" orientation and an appreciation for the interactive nature of the development steps. Two instructional approaches were developed and are described: tape/slide presentation with self-scoring answer sheets, and a computer-managed instructional system for possible future use.

Howard, Ann. Intrinsic motivation and its determinants as factors enhancing the prediction of job performance from ability. College Park, Md.: Univ. Md., Research Report No. 11 (ONR Contract No.N00014-75-C-0884), May 1976.

Purpose of this research was to explore the relationship of ability and intrinsic motivation in the prediction of job performance. Two determinants of intrinsic motivation were traced: an organizational factor and an individual difference factor. Data was collected on 335 clerical employees in 11 job groups in a large metropolitan bank. Ability and intrinsic motivation combined in an additive but not in an interactive way in predicting job performance. It was suggested that intrinsic motivation is a useful construct that is not yet well measured.

Ingham, A. S., Levinger, G., Graves, J. and Peckham, V. The ringelmann effect: Studies of group size and group performance. Journal of Experimental Social Psychology, 1974, 10, 371-384.

These studies, using undergraduates as subjects and team rope-pulling as the problem, tested the effects of increasing the size of the team on performance, and factors influencing reduced motivation. Adding two men to single puller reduced efficiency by 18% with further additions having no significant effect. Reduced motivation viewed as possibly due to no feedback. Improved motivation could result from measuring individual team members' efforts if member informed of measuring.

Insko, Chester A. and Schopler, John. Experimental social psychology. New York: Academic Press, 1972, 379-548.

This review of the research literature on small groups emphasizes how groups work. The review begins with pre-interaction variables, moves to group organization or internal variables, then to group decisions and intergroup relationships. The focus is on the end products of group interaction rather than on a specific set of independent variables.

James, L. R. and Jones, A. P. Organizational climate: A review of theory and research. Psychological Bulletin, 1974, 81, 1096-1112.

Previous organizational climate research, definitions, and measurement approaches are reviewed and differentiated into three categories: namely, a multiple measurement-organizational attribute approach, a perceptual measurement-organizational attribute approach, and a perceptual measurement-individual attribute approach. Similarities and differences between these approaches are discussed in an attempt to address a number of theoretical and psychometric concerns. A major focus is the extent to which organizational climate duplicates other organizational and individual domains. Recommendations are made for future research which include a rationale for differentiating between organizational climate and psychological or individual climate and an emphasis upon the distinction between level of measurement and level of explanation as related to future definitions of climate. (Authors)

Johnson, Steven L. Establishing training criteria on an economic basis. Orlando, Florida: Proceedings of Ninth NTEC/Industry Conference, "Readiness Through Simulation," 9-11 November 1976.

The author presents a quantitative (Bayesion economic analysis model) and a communicable framework for establishing training effectiveness criteria for use by the training specialist and the manager. The applicability of techniques developed in the areas of quality assurance, training technology and decision theory is discussed.

Jones, Allan P., Hornick, Christopher W. and Sells, S. B. A social systems analysis of the naval organization: Organizational characteristics and effectiveness of naval ships. IBR Technical Report No. 72-15, ONR Contract No. N00014-72-A-0179-0001, Fort Worth, Texas: Texas Christian University, Institute of Behavioral Research, 31 August 1972.

Organizational characteristics of naval ships were examined within the context of a social systems model consisting of eight major components: 1) objectives and goals, 2) philosophy and value systems, 3) personnel composition, 4) organization, 5) technology, 6) physical environment, 7) social-cultural environment and 8) temporal characteristics. The initial phase of investigation involved description and quantification of selected system elements and of perceived dimensions of organizational climate. Interrelated measurement approaches employed in this phase consisted of organizational climate questionnaires and structured interviews with ship officers. Detailed information on environmental factors included such factors as: chain of command, differentiation by subgroups, procedural flexibility, role structure, mission objectives, communication channels, and policies. Data on organization structure and function was obtained through Organizational Climate Questionnaires. Typical factors included were: organizational clarity, support of subordinates by supervisors, communication-downward, atmosphere of trust and efficiency to work. Differences in climate dimension scores from four minesweepers were related to other differences between the ships. The structure obtained from these ships were compared to structure obtained in previous studies of other organizations.

Kelley, Harold H. and Thibaut, John W. Group problem solving. In Lindzey, Gardner and Aronson, Elliot (Eds.) The handbook of social psychology. Reading, Mass.: Addison-Wesley Publishing Company, 1968, 4, 1-101.

The authors present several models relating to group problem solving and process, each model providing a standard with which experimental results may be evaluated. Discussion includes the models of Leavitt, Lorge and Solomon; Buchanan and Tullock; and Siegel and Fouraker among others. Research findings on the contrast between group behavior and individual behavior as influenced by the type of problem, pressures toward conformity, and the characteristics of the groups and individuals themselves are reviewed and generalizations drawn.

Kidd, J. S. A comparison of one-, two-, and three-man work units under varying conditions of work load. Journal of Applied Psychology, 1961, 45, 195-200.

Comparative analysis was made of the effect of input load and team size on the productivity of a radar approach control unit. Nine laboratory trained controllers participated in a total of 54 problems. Unit size was varied by using one, two and three operators per unit. Results confirmed previous findings that performance falls off sharply as load is increased. Reducing load per controller by increasing team size leads to only moderate increase in performance. No reliable prediction of team performance was observed on the basis of four predictor variables derived from individual performance indices. System efficiency and safety were performance measures applied.

Klaus, David J. and Glaser, Robert. Increasing team proficiency through training: 8. Final summary report. ONR Contract Nonr. 2551(00) (NR 154-079). Team Training Laboratory, American Institutes for Research, 1968.

This summary describes a series of seven studies conducted at the Team Training Laboratory, American Institutes for Research during 1960-1967. The study areas included (1) reinforcement of team responses, (2) team acquisition and extinction, (3) decrements in parallel teams, (4) effects of team arrangement, (5) team composition and membership, (6) use of supplemental reinforcement, and (7) simulation of a team environment. The authors cite the possible parallels to this team research in social psychology.

Klaus, D. J. and Glaser, R. Reinforcement determinants of team proficiency. Organizational Behavior and Human Performance, January 1970, 5(1), 33-67.

This summary describes a series of seven studies conducted at the Team Training Laboratory, American Institutes for Research during 1960-1967. The study areas included (1) reinforcement of team responses, (2) team acquisition and extinction, (3) decrements in parallel teams, (4) effects of team arrangement, (5) team composition and membership, (6) use of supplemental reinforcement, and (7) simulation of a team environment. The authors cite the possible parallels to this team research in social psychology.

Koch, James L. Effects of feedback on job attitudes and work behavior: A field experiment. Technical Report No. 6. ONR Contract No.N00014-76-C-0164. Eugene, Oregon: College of Business Administration, University of Oregon, October 1976.

This study examined the effects of feedback on job attitudes and work behavior among a sample of female sewing machine operators. Increased feedback led to significant improvements in the group cohesion and goal commitment of the operators. Moreover, marked improvements in product quality were associated with feedback from management. Turnover and absenteeism also decreased, but overall satisfaction did not increase and intrinsic job satisfaction actually decreased. Operator work expectations increased as a result of their involvement in this field experiment. Findings are discussed with reference to theoretical and practical issues in work systems redesign.

Landers, Daniel M. and Lüschn, Günther. Team performance outcome and the cohesiveness of competitive coacting groups. International Review of Sport Sociology, 1974, 9(2), 57-71.

In this study of interacting and coacting groups, questionnaires were used with 52 intramural bowling teams. It was found that bowling skill was correlated with success; that interpersonal attraction among team members was highly correlated with failure in step down analysis; and that communication between members between games correlated with success but had a high standard deviation.

Larson, O. A., Sanders, S. I. and Steinemann, J. H. Survey of unit performance effectiveness measures. Technical Report 74-11. San Diego, California: Navy Personnel Research and Development Center, January 1974.

The report provides the results of a survey conducted to determine the state-of-the-art of performance assessment systems and methodologies to support requirements for improved combat unit training in the U.S. Marine Corps. A 101-item annotated bibliography is provided.

Leih, Robert K. and Curry, Timothy J. On integrating small group concepts and models. Pacific Sociological Review, 1971, 14(1), 38-52.

This paper proposes a series of concepts pertaining to operant-oriented work, decision processes and personal strategy, bargaining and exchange relations, and more general notions such as norms leading to different types of structures. By means of these concept definitions different types of models can be integrated and a wide variety of small group research can be given theoretical continuity.

Lindgren, Henry C. Contemporary research in social psychology: A book of readings. New York: John Wiley & Sons, 1973.

The "samples" of papers includes consideration of both the scientific foundations and everyday relevance of social psychology research. Social attraction, social learning, social influence, personality, social perception, social status, communications, group process, leadership and the dynamics of aggression are included.

Lorge, I., Fox, David, Davitz, Jack, and Brenner, Marlin. A survey of studies contrasting the quality of group performance and individual performance 1920-1957. Psychological Bulletin, 1958, 55, 337-372.

This analysis of studies contrasts the quality of performance by individuals and groups in diverse situations. A classification scheme presented for a variety of groups includes (1) interacting face-to-face group divided into traditional and ad hoc,(2) noninteracting face-to-face divided into climatized and social climatized, and (3) noninteracting non-face-to-face group divided into statisticized and concocted. Judgment, memory, size of group, social facilitation, etc. are included but the principal emphasis is on productivity. A wide range of methodological issues is discussed.

Lundgren, David C. Trainer style and patterns of group development. Journal of Applied Behavioral Science, 1971, 7(6), 689-709.

Developmental trends in two 10-man training groups were studied by checklist and rating scale techniques over four days laboratory session. Groups varied by trainer attitude; inactive and nondirective at outset vs. active and directive at outset. Results show significant differences in solidarity, openness and productivity of groups - the groups with nondirective, inactive leaders being most productive.

Martens, Rainer and Peterson, James A. Group cohesiveness as a determinant of success and member satisfaction in team performance. International Review of Sport Sociology, 1971, 6, 49-61.

Questionnaires were used with intramural basketball teams to measure cohesiveness. The number of games won was used as the measure of effectiveness. Cohesiveness was found to be an important factor in team effectiveness. Higher levels of cohesiveness are associated with greater success and satisfaction. Discusses methodological problem of adequately defining cohesiveness and equivocal nature of the data on team effectiveness.

McGrath, J. E. and Altman, I. Small group research: A synthesis and critique of the field. New York: Holt, Rinehart and Winston, 1966.

Part I sets forth the classification system developed and revised by the authors to describe and integrate small group research information. They apply this system to a sample of nearly 250 studies selected from a bibliography of over 2,000 entries and discuss its broader application. Part II contains a description of empirically established facts and generalizations, gaps in the field, methodological problems, and perspectives on the cultural milieu in which small group research is carried on. Part III contains reference materials designed to aid small group researchers in review of the literature, identification of worthwhile research topics and study design.

Meister, David. Behavioral foundations of system development. Chapter V - Team functions. New York: John Wiley, 1976, 231-296.

Since the team is the most obvious feature of the multiman system, one cannot understand that system without considering the team. It follows then that one must know how individual operators are integrated into the team. These processes determine what team training will consist of and how it will be conducted. Concepts about team processes and team training have been fuzzy, focusing on crew communications. A good deal of research effort has been expended on determining whether team training results in performance improvement, and the results have been disappointing. The literature describing structural team variables (e.g., crew size, organization, and composition) is also reviewed. (Author)

Miller, Mark M. Task orientation and salience as determinants of source utility. Journalism Quarterly, 1972, 49(4), 669-673.

In this study forty-three students were divided into four groups to test salience and task orientation as determinants of source utility. Salience proved to predict source utility best, even under conditions of high task orientation.

Naylor, J. C. and Briggs, G. E. Team training effectiveness under various conditions. J. Appl. Psychology, 1965, 49(4), 223-229.

Transfer performance of three-man teams was measured as a function of two-system variables (task complexity and organization) and one training variable (skill level of a replacement for one of the team members) in a simulated radar control serial intercept task. Each independent variable influenced team performance. Task complexity had a consistent effect across all transfer sessions with superior performance on the less complex task. Task organization influenced performance only after the replacement occurred with superior performance by teams organized to permit each subject to work independently of his counterpart. The teams receiving a more highly trained replacement improved in performance immediately following; teams with a less skilled replacement actually deteriorated slightly but then recovered in a subsequent work period.

Nebeker, D. M., Dockstader, S. L. and Vickers, R. R., Jr. A comparison of the effects of individual and team performance feedback upon subsequent performance. Technical Report 75-35. San Diego, California: Navy Personnel Research and Development Center, May 1975.

This study sought to determine the effects of performance feedback presented to subjects acting singly or as members of a team. The experimental questions addressed were: (1) whether being identified as a team member enhances performance and (2) whether individual performance in groups is affected by variation in the amount and specificity of the feedback provided. Results indicated that subjects who perceived themselves as part of a team did not perform at significantly higher levels than non-team members, when the effects of feedback were controlled. Results also revealed that, although individuals performed better with than without feedback, it didn't matter whether the feedback was raw or percentile or whether it concerned the individual, his group, or both.

Nogami, Glenda Yukie. The effects of room size and group size on individual vs. group task performance. Technical Report 25, ONR Contract No. N00014-67-0226-0030. Lafayette, Indiana: Purdue University, April 1975.

Four and ten person groups of males and females were placed into 70, 40 or 16 square foot rooms. Working either as a group (interacting) or individually (co-acting), they performed a perceptual task and a problem solving task. Results indicate that there is no difference in problem solving from dense to less dense areas, replicating Freedman, Klevansky and Ehrlich's findings (1971). However, there appear to be mood and attitude differences from dense to less dense conditions, and a sex difference. With density constant (area per person), males appear to be more affected by group size while females are affected by the interaction of the room size and group size.

Obermayer, Richard W., et al. Combat-ready crew performance measurement system study. AFHRL Final Report of Contract No. F41609-71-C-0008, Air Force Human Resources Laboratory, May 1972.

This study involved development of (1) a systematic definition of performance measures appropriate to combat-crew training needs, and (2) definition of a cost-effective measurement system usable in combat-crew training environments to acquire and process needed training information. Data for performance measures were collected from several USAF bases. Measurement system criteria were based on an analysis of combat-crew training procedures. Detailed system specifications and an implementation plan were prepared. The difficulty in isolating individual performance for some aircraft crews is cited.

Olmstead, Joseph A. Small-group instruction: Theory and practice. Alexandria, Virginia: Human Resources Research Organization, 1974.

This volume is an analysis of the state of the art of small-group methods of instruction. It describes some of the more commonly used small-group techniques and the rationale behind them, and provides an analysis of their potential use for various types and conditions of instructional environments. Explicit guidelines are provided to assist trainers and training managers in selecting methods that will accomplish desired instructional objectives and in using the methods effectively.

Proskansky, H. M. Environmental psychology and the real world. American Psychologist, 1976, 31, 301-310.

Proskansky sets forth his reasons for his change of interest from laboratory social psychology to the new field of environmental psychology. He defines environmental psychology as "the attempt to establish empirical and theoretical relationships between the behavior and experience of the person and his built environment." Proskansky cites five new methodological requirements for the new field: (1) the absolute integrity of person/physical setting events, (2) the distinction between behavior-systems reactions and psychological system reactions, (3) a context orientation to problems, (4) a time orientation of environmental psychology, and (5) a context orientation in the analysis of problems.

Roby, Thornton B. Small group performance. Chicago: Rand McNally and Company, 1968.

This monograph sets forth a framework for developing theory related to task performance in small groups. Aim is to identify significant variables in performance and to illustrate research techniques for obtaining necessary empirical information. The focus is on highly specialized groups devoid of interpersonal conflict, fully accepting task objectives and conditions, and guided by agreed upon operating procedures and member roles developed over a long period of working together as a team. Within this limited specification, the analysis attends to group functional divisions, group rules and strategies and influence relationships among component processes. Three hypothesized modes of constructing a performance model - aggregation, segmentalization, idealization - are explored, together with techniques such as mathematical and computer models. Roby concludes that any serious attempt at performance prediction must be based upon a computer simulation and presents a schema of a suggested program of analysis.

Roby, T. B. and Lanzetta, J. T. Considerations in the analysis of group tasks. Psychological Bulletin, 1958, 55, 88-101.

Provides a tentative, proposed approach to the problem of describing and classifying tasks. Four stages of group-task properties are proposed: task input variables, group input variables, group output activities, test output activities, each of which can be broken down as to descriptive or qualitative nature, distribution of component events in space, functional behavior of the events. "Objective" and "modal" task properties are distinguished. The notion of "critical demands" based on broadly defined group functions is also presented. The authors note the general neglect of task parameters in small group research.

Rome, B. and Rome, S. Communications and large organizations. SDC document SP-1690/000/00. Santa Monica, California: System Development Corporation, 4 September 1964.

Report describes a number of experiments with a large organization consisting of a team of 20 to 30 members and hundreds of "agents" simulated in a computer. Real time interaction among subjects through the computer is provided. Experiments included study of organizational information processing among subsystems, exercise of authority in manpower-utilization, and evaluation of the organization under various experimental manipulations of input load, conflicting demands and KOR. Extrinsic KOR organized by subsystem function was found to be insufficient for team improvement. Very significant improvement (300 percent) resulted from total system debriefing. Other experiments involved organizational structure and crises environment changes, and substitution of systems reports by exception for comprehensive feedback.

Rosenberg, S. A laboratory approach to interpersonal aspects of team performance. Ergonomics, 1959, 2, 335-348.

Rosenberg tested the hypothesis that in a complex task team members did not learn coordination skills because they had not yet learned the task well enough. Using individually pretrained subjects assembled in combination with other trained and nontrained subjects, he found no differences in degree of role differentiation and less role differentiation among pretrained members. He concluded that distribution of responsibility is difficult to develop in complex tasks and this failure is not due exclusively to failure to master the task. These findings point to the need for adequate team training to produce optimal team performance rather than simply assembling individually trained members.

Rosenberg, S. Cooperative behavior in dyads as a function of reinforcement parameters. Journal of Abnorm. Soc. Psychology, 1960, 60, 318-333.

Rosenberg studied the effect on team performance of combining feedback in various ways and providing various degrees of specificity of feedback, i.e., whether an error has occurred vs. direction of error. His results indicated that comparative behavior develops and team performance improves when feedback is specific and when both subjects receive feedback which weights their own responses 50 percent or more.

Rosenberg, S. and Hall, R. The effects of different social feedback conditions upon performance in dyadic teams. Journal of Abnormal Soc. Psychology, 1958, 57, 271-277.

Using a knob-turning task and two-man teams, the authors investigated the effect of three feedback conditions (direct, confounded and "other") on individual and team accuracy. "Other" involved feedback on adequacy of their partner's response. The results for individual accuracy showed that for rate and ultimate level of learning, direct was superior to confounded, and "other" showed no learning. When team accuracy scores are considered, direct and confounded feedback produce equal learning rates and levels and both were better than "other" condition. In a replication experiment, confounded feedback produced a higher level of learning than direct feedback.

Samuels, Frederick. The intra- and inter-competitive group. Sociological Quarterly, 1970, 11(3), 391-396.

This study investigated the effect of different types of reward distribution on group structure. Three-member groups of each of four different reward-distribution types were studied. In a task involving circular jigsaw puzzles, it was found that intra- and inter-competitive groups had the greatest intra-group like-ability and showed the most positive behavior.

Shure, G. H., Rogers, M. S., Larsen, I. M. and Lassone, J. Group planning and task effectiveness. Sociometry, 1962, 25, 263-282.

Using 150 college males divided into 30 five-man groups on a hidden symbol task, results of this experiment indicated that groups given a separate planning period between trials were significantly faster than co-temporal planning or no-planning period groups. The findings supported the hypothesis that normal efforts to organize in newly formed groups is subverted by task pressures creating a sense of urgency and panic (Cattell's "horde urgency" factor).

Smith, Clagett G. Scientific performance and the composition of research teams. Administrative Science Quarterly, December 1971, 16(4), 486-495.

This study examined the relationships among several dimensions of team composition and performance of 49 teams in an industry research laboratory. Heterogeneous team membership was associated more frequently with superior success in all aspects of performance.

Smith, David Horton. A parsimonious definition of "group:" Toward a conceptual clarity and scientific utility. Sociological Inquiry, 37(2), 1967, 141-167.

The author identifies necessary and sufficient conditions for the occurrence of group-like phenomena, presents a definition of "group," and evaluates the definition in terms of the criteria of utility, clarity and parsimony for applications in any given social system. The definition: A group is defined here as (1) the largest set of two or more individuals who are jointly characterized by (2) a network of relevant communications, (3) a shared sense of collective identity, and (4) one or more shared goal dispositions with associated normative strength.

Smode, Alfred F. Recent developments in training problems, and training and training research methodology. In Glaser, Robert (Ed.). Training research and education. Pittsburgh:University of Pittsburgh Press, 1962, 437-441, 479.

Reviews new ways of providing learning experiences, new types of problems or tasks including team training and small group research. Emphasizes several needs for information including how a team functions, relationship between group structure and operation to team performance, optimum training procedures for teams in a systems context, and ways of augmenting information feedback to facilitate performance.

Sorenson, James R. Task demands, group interaction and group performance. Sociometry, 1971, 34(4), 483-495.

This study investigates the relationships between task demands, group interaction profiles and group performance through the use of 28, three-man problem-solving groups. Guidelines for study provided by the use of the Collins and Guetzkow model of processes in decision-making, Results indicate that task demands significantly shaped task interaction profiles; task demands affected only one quality dimension of group performance, contrary to previous studies; and that levels of group performance and task specific behaviors were significantly correlated. Sorenson concludes that this research suggests need for simultaneous study of selected input, process and output variables.

Sorenson, James R. Group member traits, group process, and group performance. Human Relations, 1973, 26, 639-655.

One hundred fifty male undergraduates matched for S.A.T. verbal ability scores were divided into 16 three-man groups and were required to create a story or poem and solve an intellectual problem. Subjects were grouped on the basis of Remote Associates Test and Social Differentiation scores. Results indicate group with high S.D. were best on quality of performance; high R.A.T. best on originality; high S.D.-R.A.T. best on evaluativeness.

Spoelders-Cloes, Rita. Small-group effectiveness on an administrative task as influenced by knowledge of results and sex composition of the group. European Journal of Social Psychology, 1973, 3(4), 389-401.

Two experiments were designed to test E. A. Locke's theory of task motivation and incentives. Hypothesis: Motivational knowledge of results will influence task performance through its effects on intentions and goal setting. Results: No significant influence of knowledge of results on small group effectiveness; no significant influence of sex on effectiveness. Both findings support Locke's theory.

Steers, Richard M. Problems in the measurement of organizational effectiveness. Technical Report No. 1. ONR Contract No. N00014-76-C-0164. Eugene, Oregon: Department of Management, University of Oregon, November 1975.

This paper reviews 17 multivariate models of organizational effectiveness in terms of their primary evaluation criteria, their normative or descriptive nature, their generalizability, and their derivation. Little consistency was found in the evaluation criteria of the models. Eight problems of such models are discussed which appear to reduce their utility for the study of organizational effectiveness. Suggestions are advanced for future work to focus on operative goals and goal optimization to further our understanding of the effectiveness construct in on-going organizations.

Steers, Richard M. and Mowday, Richard T. The motivational properties of tasks. Technical Report No. 7. ONR Contract No. N00014-76-C-0164. Eugene, Oregon: Graduate School of Management and Business, University of Oregon, September 1976.

This paper reviews six conceptual models of the motivational properties of tasks which have been presented recently in the literature. Each model is examined in terms of its scope and specificity in explaining motivational processes associated with task design. Specific suggestions are offered for future research aimed at improving the utility of such models for both investigators and managers. The need for more rigorous experimental designs and empirical data is emphasized.

Steers, Richard M. and Porter, Lyman W. The role of task goal attributes in employee performance. Technical Report No. 24, ONR Contract No. N00014-69-A-0200-9001, Irvine, California: University of California, 1974.

Research related to six factor-analytically derived attributes of employees' task goals is reviewed to ascertain which attributes are most consistently related to performance. The six "task goal attributes" are goal specificity, participation in goal setting, feedback, peer competition, goal difficulty and goal acceptance. Goal specificity and goal acceptance were found to be most consistently related to performance; however, several intervening variables emerged which affect significantly the impact of certain attributes on performance. It is argued that performance under goal-setting is a function of at least three important variables: the nature of the task goals, additional situational-environmental factors, and individual differences.

Steiner, I. D. Group dynamics. In Farnsworth, P. R. (Ed.), Annual Review of Psychology. Palo Alto, California, 1964, 15, 421-446.

Steiner concludes from his critical review that both the volume and the methodological sophistication of research increased during the three preceding years. No striking changes were found in conceptual orientation, except for increasing reliance on mathematical models. Theories continue to be eclectic in character and limited in scope. Failure to observe ongoing behavior was very apparent in studies of interpersonal perception, attraction and group productivity. Steiner agreed with the previous reviewer that "the future looks bright."

Steiner, I. D. Group processes and productivity. New York: Academic Press, 1972.

This book stresses the integrative role of task demands and group processes. Steiner inspects a limited number of phenomena in an orderly and systematic fashion, and describes a small but consistent network of interrelationships within his "modest" theory. Potential and actual productivity are treated as dependent variables and attention is focused on the factors that influence them.

Terauds, A., Altman, I., and McGrath, J. E. A bibliography of small group research. Report HSR-RR-60/2-Gn. Arlington, Virginia: Human Sciences Research, Inc., April 1960 (AD 237-304).

Report contains a comprehensive (2,142 items) bibliography of small group research studies through 1959. This report is one of several prepared for the Air Force Office of Scientific Research under a contract initiated in 1957 and on-going at the date of this bibliography. Previous related bibliographies are identified.

Terborg, J. R., Castore, C. H. and DeNinno, J. A. A longitudinal field investigation of the impact of group composition on group performance and cohesion. Technical Report 80. ONR Contract No. N00014-67-A-0226. Lafayette, Indiana: Purdue University, May 1975.

In a three-month field experiment, 42 groups were assembled on the factors of individual ability and attitude similarity. For each of six projects, measures of group performance and group cohesion were taken. Analyses showed that high ability groups exhibited the best performance whereas attitudinally similar groups expressed the greatest cohesiveness. In addition, correlational data suggest that the effect of attitude similarity on cohesion is not immediate, but develops over time; and that across the six projects, performance can be positively and negatively related to cohesion.

Turney, John R. The cognitive complexity of group members, group structure, and group effectiveness. Cornell Journal of Social Relations, 1970, 5(2), 152-165.

Simulated business game was used in an attempt to relate meaningful individual differences variable to group effectiveness. Thirty-five male undergraduates arranged along continuum of cognitive abstractness-concreteness, in eight groups. Results show groups with majority of cognitively abstract members were more effective than groups with a majority of cognitively concrete members.

U. S. Air Force. Handbook for designers of instructional systems (Evaluation). AFP 50-58, 15 July 1973.

This five-volume pamphlet provides guidance in applying the Instructional System Development process described in AFM 50-2. The pamphlet is for the use of education and training personnel who plan, develop, approve, administer, or manage Air Force instruction and supporting materials. Volume V, Evaluation, provides guidance on how to conduct an internal evaluation and a field evaluation of an operating instructional system.

U. S. Air Force. Instructional system development. AF Manual 50-2, 31 December 1970.

This manual serves as the guide for applying the Air Force systems approach to the development of education and training programs. It presents a technology of instructional design and presents the model for developing cost-effective instructional systems. This manual applies to all education and training personnel who plan, develop, approve, administer, or manage Air Force instruction and its supporting materials.

U. S. Army. A cost assessment of army training alternatives. Research Problem Review 75-3. Alexandria, Virginia: ARI for Behavioral and Social Sciences, August 1975 (Reprinted March 1976).

The army has developed a system of self-paced audiovisual lessons--the Training Extension Course (TEC)-- designed to upgrade individual skills and to help commanders conduct this individual proficiency training. This report compared the estimated cost data of TEC training with conventional Army classroom instruction. Use of TEC individualized instruction with either cassette tape or audiovisual aids was projected to be less costly in comparison to conventional instruction as volume of use increases.

Valentnova, N. S. and Myedvyedyev, V. V. Selected problems of small groups in sports teams. International Review of Sport Sociology, 1973, 8(1), 69-77.

This study of important factors in producing effective, harmonious group activity, used water polo players and football players as subjects. The groups characterized by harmonious activity and mutual understanding performed best. Groups with clearly defined leadership combined with "mixed" leadership had the best coordination of activity.

Wagner, H., Hibbits, N., Rosenblatt, R. and Schulz, R. Team training and evaluation strategies: A state-of-art review, SR-ED-76-11, Alexandria, Virginia: HumRRO, June 1976.

An extensive and critical review of the literature is presented. A classification scheme was introduced in which the training situations covered were categorized as "emergent" (some discretionary behavior permitted because all activities cannot be predicted) or "established" (tasks and required behaviors almost completely specified). Team training is distinguished from "multi-individual" training. State-of-the-art gaps are identified and new techniques are suggested for study of their applicability to team training.

Weinstein, A. S. and Holzbach, R. L. Impact of individual differences, received distribution and task structure on productivity in a simulated work environment. Journal of Applied Psychology, 1973, 58, 296-301.

Study involved 72-male undergraduates divided into 3 groups using coded responses to a questionnaire on standardized forms found: (1) differential reward increased productivity (i.e., within a group, the subjects with best performance received more money), (2) intra-group task division reduced performance, and (3) competition lowered satisfaction with performance.

Wilson, Stephen R. Some factors influencing instrumental and expressive ratings in task-oriented groups. Pacific Sociological Review, 1970, 13(2), 127-131.

This study involved experimental efforts to determine the effects of task-interest of the individual group member, the competence of another contributing member, and the directiveness of the other person. It was found that these effects support the author's explanation that: (1) in lab groups where task-interest is low, a member can recognize that certain members contributed to solution without particularly liking those persons for it; where task-interest is high the individual member should be attracted to contributing members; (2) those contributing to task tended to be "directive" and therefore not liked, especially when task-interest is low.

Workie, A. The relative productivity of cooperation and competition. Journal of Social Psychology, 1974, 92, 225-230.

Study involved 240 high school male students from largely upper-middle class Jewish families on card-matching task. Results from 6 groups (40 each) were: (1) intra-group cooperation more productive than intra-group competition, (2) inter-group cooperation more productive than inter-group competition, and (1) in all cases cooperation better than no reference group whose performance was better than competition. Generalization limited.

Zagorski, H. J. Normative evaluation in the operational environment. Santa Monica, California: System Development Corporation, 12 December 1973.

The author provides a description of the development, assessment and validation of the experimental and operational form of the NORM (Normative Operations Reporting Method) as "an automated, statistically-based evaluation system that is being used today in military performance assessment in complex environments." Discussed are the NORM program system, performance data base, analysis support package, and key assessment features, together with an application in a hospital measurement and evaluation context. The example is discussed within the seven basic processes that must be executed to achieve a NORM system.

Zajonc, R. B. The effects of feedback and group task difficulty on individual and group performance. ONR Technical Report No. 15, NOvember 15, 1961.

Zajonc studied the effects of direct and confounded feedback under conditions which did not permit the mutual compensation of errors by team members. A seven-man team, a signal light stimulus, two independent variables (mixed and confounded feedback) and criterion of group performance (individual and team speed of reaction) was involved. Subjects were trained individually to an asymptotic level of performance and then operated as a group. Zajonc found: (1) individual performance improved beyond asymptotic level when subjects worked in a group, (2) both individual and group performance improved more under mixed than confounded feedback when compensation was not possible, and (3) individual performance did not change uniformly among all group members, i.e., slow performers were more sensitive to task difficulty than to type of feedback but the opposite was the case with fast performers.

Zajonc, R. B. The requirements and design of a standard group task. Journal of Experimental Social Psychology, 1965, 1, 71-88.

Components of a standard group task (SGT) are set forth in terms of individual psychology foundations; responses common to any population; quantitative assessment of behavior as individual and as group member; allowance for manipulation of interdependence without changing basic character of responses; and manipulation of parameters as to task difficulty, probability of success, complexity, and achievement of performance feedback. Additional general factors are economy of data collection, stability of observations, and repeatability for some subjects.

Zander, Alvin. Group aspirations. In Cartwright, D. and Zander, A. (Eds.) Group dynamics research and theory. New York: Harper & Row, 1968, 418-429.

This chapter contains a summary of findings from a series of studies in the origins and effects of group aspirations sponsored by the U. S. Air Force and Office of Education. In addition to the broader significance, results and conclusions relating to group performance are relevant. Ten conclusions are reported from the findings of the various studies.

Zander, Alvin. Motives and goals in groups. New York: Academic Press, 1971.

Presents a summary of the results of a program of studies into a group aspirations and members' motives. Primary attention in the investigations was given to members' plans or actions on behalf of the whole group, and little attention was given to the interaction among members. Substantive areas include group goals, group level of aspiration, external social pressures, personal motives and desire for achievement, and group performance and productivity factors and evaluation. The results are summarized first in the form of research outcomes related to a set of basic assumptions suitable for discussing why aspirations happen as they do, and second in terms of a number of variables and the events which follow from the presence of each.

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