An Essay and Resource Guide for Dyadic and Group Task Selection and Usage

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Abstract

The role of task is a critical issue of experimental IS research on group communication and decision making. This manuscript attempts to assemble a collective resource for informing IS group researchers about some of the important issues related to tasks. It includes a brief essay describing six critical factors in task selection and design. Two appendices summarize some important task concepts from the group literature and present a library of existing research tasks.

Preface

"*All studies of group task performance, of course, use some task. Many use two or three; very few use more than that. But the choice of task is often a matter of convenience and fairly arbitrary. Even when a study uses two or three tasks, those tasks may be selected haphazardly; or, at best, they may be selected ad hoc to represent simplified classifications (such as motor versus intellectual, or easy versus difficult). If tasks really make a difference -- and everyone agrees that they do -- then it seems worthwhile to devote some of our efforts to analyzing and classifying tasks in ways that relate meaningfully to how groups perform them.*" (McGrath, 1984; p. 53)

These words from McGrath succinctly set the stage for this essay and its appended resource guide. Tasks which are used for information systems (IS) experimental research should be selected with great care; with the experimenter cognizant of the potential pros and cons that the selection of a particular task may bear. IS researchers have aggressively investigated the potential role of technology (Group Support Systems, GSSs) to assist group communication and decision making. A review of the GSS literature, however, suggests that the topic of task selection and task congruence to the research question merit renewed attention. This observation is one motivation for this brief essay.

Some IS research does appear to have used tasks that were selected in an *ad hoc* manner; without significant consideration given to how the choice of task would impact the utility of the research. Furthermore, subjects who participate in some IS laboratory experiments have been directed to perform group activities in an extremely artificial context that is generally quite different from the natural contexts of organizations (e.g., in terms of an absence of political issues, the interrelatedness of problems, power and status differences). Consequently, there is no guarantee that subjects were interested in the content of the task nor that they took a stake in the group's product. Assessment of technology's impacts on such behavior is unlikely to be interesting or to produce a substantive contribution.

Experimental tasks are used in laboratory (and field) experiments to function as surrogates for *natural tasks*; that is, tasks which *natural groups* encounter in *natural settings* (McGrath, 1984). Unfortunately, experimental tasks too frequently lack many of the dimensions (e.g., high task complexity, low information clarity, participant involvement, limited implications outside of the laboratory setting) inherent in natural tasks and therefore may represent poor surrogates for natural tasks. This potentially limits the external validity and generalizability of laboratory experiments[1] and probably accounts for much of the contradictory findings between field and laboratory research which is reported in the literature (e.g., Dennis & Gallupe, 1993; Dennis et al., 1991).

Given these considerations, we set out in this essay to describe some of the issues that are important in selecting, designing, and using experimental tasks. To achieve this objective, we have chosen to document our experiences with designing and implementing experimental group research, particularly as these experiences relate to experimental <u>task selection</u> and <u>task design</u>. This essay is not intended to be exhaustive of task-related issues, rather, it is meant to provide a guide which researchers can use to focus their efforts in similar endeavors.

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[1] Some laboratory research is conducted strictly or the purpose of theory building. In such cases, external validity may consciously be sacrificed to gain experimental control.

This manuscript is organized in three sections. We begin with an essay which describes six critical task issues and documents our thoughts and experiences related to the development of the School of Business (SOB) Policy Task (Wheeler & Mennecke, 1992, see also Appendix B). This task was created to address a particular research design for decision-making groups (Wheeler, Mennecke, & Scudder, 1993). This is followed by two appendices which form the resource guide to accompany this essay.

Appendix A presents a summary of some important literature on the nature of tasks. This summary is intended to provide quick assess to the thoughts of others who have shaped our understanding of research tasks. It includes important task classification frameworks, important issues in assessing task complexity and symmetry of group information, and our own extensions of some of these concepts. Appendix B assembles about 30 research tasks in a *task library*. We are most grateful for the assistance of many researchers who contributed tasks for this task library. We have made every effort to properly cite the originator of the task whenever possible.

To Buy, Borrow, or Build: Issues in Searching for the *Right* Task

When researchers design an experiment, one of the first considerations they make should relate to the task. The selection of the task is one of the most critical decisions a researcher makes in designing an experiment (Hackman, 1968; Hackman & Morris, 1975; McGrath, 1984; Mennecke & Wheeler, 1992; Nunamaker, Dennis, & Vogel, 1991). Task selection is often hampered, however, both because of the limited availability of adequate tasks and because researchers often have a limited knowledge of the potential interactions that exist between tasks, individual subjects, and subject groups. We encountered each of these constraints as we began to design our research (Wheeler, et al., 1993).

The study we undertook was an examination of decision-making groups using a group support system (GSS). We manipulated restrictiveness -- the degree of structure imposed on the group members via a GSS-enabled heuristic (i.e., a structured decision technique) and individual subjects' preference for procedural order (PPO) (see Wheeler, et al., 1993; Putnam, 1979). To examine these issues, we concluded that we needed a task that possessed several specific characteristics (see Table 1). The task characteristics we focused on are those which had the greatest potential to influence the results of our study. We based these conclusions both on our experiences in working with groups and experimental tasks as well as on the task literature described in Appendix A.

Appropriateness of the Task for the Subjects	The task should present a situation within the realm of most subject's experiences and capabilities. The task should be designed so that subjects have or can acquire the skills or knowledge needed to complete the task.
Subject Intellectual Engagement	To yield useful measures of group interaction and performance, the subjects must be mentally engaged in processing the task. For example, an effective way to generate high subject involvement is to create among the subjects a perception that they have a stake in the outcome.
Control for the Differences in Subject Preferences, Needs, and Experiences	The task should create an environment in which differences between subjects in terms of individual preferences and needs are minimized. To help to identify and isolate the relative impacts of the experimental manipulations, a task which minimizes or eliminates systematic biases should be used.
The Level of Task Complexity	Extant organizational groups are frequently faced with the responsibility for solving complex tasks. Task complexity can be manipulated by varying the quantity of information, the quality of information, and/or the degree of integration necessary to process the task.
Conjunctive Versus Disjunctive Task	For disjunctive tasks, the problem and possible solutions are obvious (Eureka tasks). Such tasks may often be solved by an individual as well or as easily as a group. Conjunctive tasks, on the other hand, like many real world problems, do not necessarily have an obvious correct answer and require participation of all group members in order for the group to be successful in solving the task.
Measurement of Solution Quality	Intellective experimental tasks are often preferable to decision-making tasks because intellective tasks allow the experimenter to evaluate decision quality and relate this to the experimental manipulations and group process.

Table 1
Critical Task Issues

Appropriateness of the Task for the Subjects

One of the factors that we considered to be critical in task selection is the appropriateness of the task for the subjects who are asked to perform it. Of particular importance in this context is the understanding which subjects are likely to have of the task and their ability to process and perform the critical task requirements. The model proposed by Hackman (1969) and Mennecke & Wheeler (1993) (see Appendix A) highlight the importance that task redefinition as well as the individual subject capabilities have on a subject's performance of the task.

Often researchers wish to minimize unanticipated variances associated with task redefinition. In such circumstances, tasks should generally be designed so that each subject has an equal opportunity to understand and process both the instructions and the task materials. Furthermore, McGrath (1984) has suggested that the background and experiences that subjects bring to their processing of the task are also important. Therefore, the task should present a situation to the subjects which is within the realm of the subjects' skills, knowledge, and experiences. The SOB Policy Task, for instance, was designed so that the scenario described in the case was similar to the business school from which the population of subjects were recruited. Because of this, the subjects who processed the task could bring their own experiences and knowledge of the problems and constraints into the discussion of the case. Furthermore, the task was designed so that each participant was assigned a specific defined role. The use of assigned roles in a task such as this can potentially help to increase the involvement which group members have in the task via the real need to share information.

Subject Intellectual Engagement

In pilot tests for our research, we evaluated several experimental tasks and found that subjects often did not exhibit behaviors consistent with high involvement in the task. Therefore, a second objective in developing the SOB Policy Task was to create a scenario in which subjects were likely to be intellectually involved in processing the task. To accomplish this, we recognized that subject's needed to be provided with significant motivation. This motivation could have been derived intrinsically, extrinsically, or from a combination of sources. We chose to develop the case so that significant intrinsic motivation would be generated within the subjects. This was accomplished by structuring the case so that it described a scenario which subjects were intimately familiar with (a business school program similar to the one through which they were matriculating) and in which they would likely believe that they had a significant and potentially long-term stake (improving the school of business program would generally be perceived as being beneficial).

The significant point to be made here is that motivation is a critical issue in task selection and use. Researchers studying small groups have often relied on extrinsic motivation, particularly financial rewards. While this has no doubt helped to motivate subjects in many circumstances, the impacts of such rewards are often short term and, as a result, limited. We feel, therefore, that it is often preferable to motivate subjects using intrinsic forms of motivation, particularly those that lead to acceptance and internalization of the task goals and objectives. This is particularly important since reward systems in organizational settings often rely on intrinsic forms of motivation.

Control for the Differences in Subject Preferences, Needs, and Experiences

In our consideration of tasks for our research, we also concluded that the task we selected should provide us with as much control as possible. The task processing models proposed by Hackman (1969) and by Mennecke and Wheeler (1993) both highlight the fact that subjects will redefine the task instructions and stimuli as they process the task (see the models in Appendix A). These models imply that the different experience and biases which subjects bring to the group will differentially impact the way in which subjects interpret and redefine the task. Although researchers may design their studies with the specific objective of identifying how individual characteristics impact task performance (i.e., using a task as behavior description definition; see Hackman, 1969, in Appendix A), often researchers are interested in how certain task characteristics interact with an experimental manipulation (i.e., using a task as behavior requirements definition; see Hackman, 1969, in Appendix A). In the latter circumstance, it is important that task effects associated with individual differences within each treatment are minimized.

To minimize these variances, it is important that the instructions and task stimuli given to subjects are delivered consistently and clearly. A simple yet effective way to accomplish this is to use written instructions or to deliver verbal instruction via a recorded medium (e.g., videotape) or from a written script. Beyond these basic procedural issues, however, it is often important to design the task so that it minimizes impacts due to differences between subjects. For subjects who are recruited from a relatively uniform population (e.g., a school of business), we suggest that a task which is designed to *tap into* experiences and biases that are common to members of that population will help to reduce the variance associated with differences between subjects. For example, we designed the SOB Policy Task so that it described a scenario to which business students could relate and incorporate their common experiences as they processed the case.

The Level of Task Complexity

We wanted to create a scenario in our research which would allow us to generalize our results outside the experimental environment. Nunamaker et al. (1991) suggest that one of the key differences between organizational groups and experimental laboratory groups is task complexity -- organizational groups often process highly complex tasks while laboratory groups often process tasks low in complexity. Therefore, we designed the SOB Policy Task with the objective that it would be highly complex. The task contains five unique roles, each of which has a stake in the policies of the business school. Case-relevant information is split across multiple roles so that it can only be utilized through a conjunctive group effort. In addition, the problems which the group must address are not overtly identified which increases both the realism and complexity of the case.

Wood (1986) proposed a framework for classifying tasks based on complexity. He suggested that the task complexity construct is defined by three distinct types of task complexity: *component complexity*, *coordinative complexity*, and *dynamic complexity*. In terms of Wood's model, the SOB Policy Task ranks high in complexity on all three dimensions. For instance, approximately 75 unique facts are presented in the case which implies that component complexity is relatively high. Further, coordinative complexity is high since these facts are distributed among group members such that each member has only a subset of the relevant facts. This requires groups to identify and surface unshared information, a process which has been shown to be difficult for groups to do successfully (Stasser & Titus, 1985, 1987; Stasser, Taylor, & Hanna, 1989). Finally, dynamic complexity is moderately high since the nature of the group problem and focus shifts as *new* information is shared and the group recognizes new issues that need to be addressed.

This discussion of the task complexity construct and its application to a specific task, the SOB Policy Task, was presented to highlight the importance of conceptualizing tasks and task complexity as multidimensional. In particular, we feel that it is important that task classifications which are used by researchers incorporate the task complexity construct. One problem with Wood's framework, however, is that it does not incorporate a classification mechanism such as that proposed by McGrath (1984) which distinguishes between tasks based on the objectives and behaviors upon which the task is focused. We offer such a framework in Appendix A for use in classifying tasks that are used in future research.

Conjunctive Versus Disjunctive Task

In our attempts to create a more complex task, we concluded that one approach which we could use to accomplish this goal was to distribute case-relevant information among the group members *asymmetrically*; that is, such that no one group member possessed sufficient information to solve the case individually. A task with an asymmetrical distribution of case-relevant information is called a *hidden profile* task (see Appendix A). Stasser (1992) defined a hidden profile scenario as follows:

> *"A hidden profile exists when the superiority of one decision alternative over others is masked because each member is aware of only one part of its supporting information, but the group, by pooling its information, can reveal to all the superior option"* (p. 49).

Hidden profile tasks are a type of conjunctive task since the success of the group is dependent on the contributions of the individual member who is least likely to share information with the group. In other words, hidden profile tasks are structured so that each group member does not receive the same information and the information that each member does receive is not adequate by itself to optimally solve the case. However, collectively the group has enough information to find the optimum solution. The inclusion of an asymmetrical distribution of information in the group adds a new dimension of complexity to experimental tasks because individual group members must now not only process the task materials that are shared among the groups participants, but they must also successfully communicate unshared information via verbal or technologically-enabled (e.g., GSS) communication channels.

We contend that hidden profile tasks have the potential to address some of the important "disconnects" between laboratory experiments and field research that have been noted by several authors (e.g., Dennis, Easton, Easton, George, & Nunamaker, 1990; Dennis & Gallupe, 1993; Dennis et al., 1991; Mennecke et al., 1992). Specifically, these tasks provide experimenters with a way to manipulate the logical size of the experimental group. Nunamaker, Vogel, & Konsynski (1989) note that:

> *"A physically large group from a common culture ... may have a high degree of overlapping domain knowledge that results in the group being logically small. Conversely, a physically small multi-cultural group exhibits characteristics of a much larger group because its members have multiple and often conflicting perspectives, points of view, diverse knowledge domains, and opinions that make it logically large"* (p.147).

In many organizational group meetings, members often come from different disciplines and units from within the organization. The very reason that these groups meet is to bring together individuals with a variety of skills and domain knowledge to address a task or project. Therefore members of these groups will often possess different conceptions of the problem or task and they also may view the task from diverse perspectives. Nunamaker et al. (1989) and Dennis et al. (1991) suggest that many, if not most, field studies have probably looked at groups which are much larger in logical size than the typical experimental groups of comparable physical size. This difference is made more pronounced by the fact that experimental subjects in the laboratory generally receive tasks that are "neatly packaged and small in scope" (Dennis et al., 1991; p. 116) with the same instructions and information presented to each participant. We feel that the logical size of experimental groups can be increased by the use of hidden profile tasks and that this offers the opportunity to extend the generalizability of some experimental research.

Task Typologies and Measurement of Solution Quality

Finally, we sought an intellective task; that is, a task which has a correct solution. Often the performance of groups in organizational settings are evaluated primarily on the product that the group generates; that is, the group's solution. For our research, an intellective task (see McGrath, 1984, and Appendix A) was preferable because we needed a means of quantitatively evaluating the impacts that our experimental manipulations had on the performance of each group. Constructing a complex task in which group performance could be quantitatively evaluated proved to be challenging. Hundreds of man-hours were required to parse the subject generated potential solutions to the case and then to score them via a panel of judges against the information in the case.

While this type of task was required for our research, this is obviously not always the case. For instance, often researchers are primarily interested in examining variables such as social interactions, individual preferences, or participant satisfaction. For these and other variables, a task involving issues that are subjective in nature or which require decisions that are made based on personal preferences or judgements (McGrath's decision-making tasks; see Appendix A) are often more appropriate.

McGrath (1984) defined a typology of tasks which distinguishes between these two task types as well as six others. This classification system is very useful for distinguishing between tasks based on the task objectives or outputs and on the types of behaviors that the group members are asked to perform. The McGrath framework is built on the task qua task and task as behavior requirements task definitions and is a theoretically sound task typology (also see our proposed extension to McGrath's model in Appendix A). The important point in this discussion is that in selecting tasks for research studies, researchers need to be cognizant of the key differences that exist between tasks and select or design tasks so that the task type matches the research objectives. As McGrath suggested,

> "*If we want to learn about groups as vehicles for performing tasks, we must either* (a) *assume that all tasks are alike, in regard to how groups of various kinds can and do perform them; or* (b) *take into account differences in group performance as they arise from differences in tasks.*" (McGrath, 1984; p. 53)

Closing Comments and Conclusions

In this essay, we have discussed a number of issues that we believe are important in selecting the right research task. This discussion primarily documents our experiences and goals related to the development of the SOB Policy Task, a hidden profile task designed to create a realistic and complex case for student subjects. In the process of documenting these experiences, we have also discussed a number of critical issues that researchers must commonly address as they design their research. We have included in the appendices a review of some of the key literature related to task definition and classification as well as a library of many experimental tasks. We are hopeful that this review and these resources represent a useful guide to others as they consider selecting and / or designing experimental tasks.

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Appendix A

A Review of the Task Literature

Task Literature Review

The task which experimental groups are asked to undertake has proven to be one of the chief moderators of group behavior and effectiveness (Hackman & Morris, 1975; McGrath, 1984; Poole, Siebold, & McPhee, 1985). Since groups engage in many different collective activities, a number of task typologies and descriptions have been presented in the literature in an effort to better define and understand the critical role of tasks and the associated group processes. While not exhaustive, we present a short discussion of many of the important task typologies that have been proposed in the psychological, communication, and information systems disciplines. The frameworks are presented in a chronological under the name of the author(s) who proposed or popularized each system. The frameworks are useful for understanding how tasks can be classified and distinguished and we feel that a review of these systems will help the reader to be sensitive to the important issues that researchers face in selecting research tasks. This section concludes with a synthesis of several of these framework.

Roby & Lanzetta

Roby and Lanzetta (1958) proposed one of the first useful task classification systems. Their approach to classifying tasks required first an analysis and definition of the properties of the task. They suggested two properties: *objective* properties, which represent inherent and quantifiable task characteristics (i.e., the *task qua task description* of Hackman, 1969); and *modal* properties, which represent those typical behaviors which groups or individuals exhibit while processing the task (i.e., the *task as behavior description* of Hackman, 1969). They also suggest that a task classification should involve a description of the properties of the relationships between critical task events (e.g., between input and output activities). Three properties were proposed: descriptive aspects, which concern the qualitative and quantitative nature of the events;

the spatial distribution of the component events; and the functional behavior of the events, which is the distribution of the events over time. Based on these "molecular properties," critical task demands or behavioral requirements can be identified and used to classify and distinguish between tasks.

The importance of this task typology is that it represents one of the first systems for quantifying tasks based on both objective task characteristics and behavioral requirements. Subsequent task typologies, particularly those of Hackman (1969), McGrath (1984), and Wood (1986), were built on this system.

Hackman

Hackman (1969) proposed a framework for examining how individuals process tasks. Hackman examines three issues related to understanding experimental tasks: 1) issues associated with defining the components and characteristics of an adequate task definition; 2) issues associated with understanding what are the most appropriate bases for making task descriptions and comparisons; and 3) issues associated with understanding task effects (i.e., how task factors influence how people think and behave).

In terms of issues related to characteristics of task definitions, Hackman (1969) focuses on two issues that he suggests are important for distinguishing between definitions of tasks: 1) the degree to which the task is conceptually distinguished from the situational context; and 2) whether the task is considered to be extrinsic (imposed by the researcher) as opposed to being intrinsic to the subject as he/she redefines the task. For situational influences, Hackman points out that many researchers (e.g., McGrath & Altman, 1966; Hare, 1962) have suggested that tasks cannot be defined without defining the environmental characteristics (i.e., the context) in which the task is used (Hackman, 1969). However, since such an approach cannot be generalized without first defining a general contingency model of situational effects (and since no such theory is available), tasks must be considered in terms of the limited situations with which we are familiar; i.e., laboratory environments. The second issue associated with defining tasks is that of task redefinition. Hackman points out that the task becomes "what the group members subjectively define it to be" (Hackman, 1969; p.102) rather than that which the researcher necessarily intended the task to be. This presents obvious problems in defining tasks (especially group tasks) since the redefinition of the task will vary on an individual basis from subject to subject.

Hackman (1969) reviewed and synthesized four frameworks for task descriptions originally put forth by McGrath and Altman (1966) and Ferguson (1956). The four frameworks are labeled *task qua task*, *task as behavior requirement*, *task as behavior description*, and *task as ability requirement*. A description of these task definitions is presented in Table 1. After reviewing these methods for describing tasks, Hackman concludes that the *task as behavior requirement* represents the best basis for defining tasks since it differentiates tasks based on the critical behaviors required for success (which will remain relatively constant for a task across subjects). The *task as behavior description* and *task as ability requirement* approaches are unsuitable since they rely on characteristics of task performers (which vary across individuals for any one task). He also finds that

Task Qua Task: *What pattern of stimuli are impinging on the subject?* These are the objective dimensions of the task such as the physical nature of the task, its subject matter, characteristics of the stimuli.

Task As Behavior Requirements: *What responses should the subjects emit, given the stimulus situation, to achieve some criterion of success?* These are the critical success factors that are needed to complete the task successfully.

Task As Behavior Description: *What responses does the subject actually emit, given the stimulus response?* These are the actual behaviors that people engage in when they are confronted with the task.

Task As Ability Requirement: *What are the patterns of personal abilities or traits which are required for successful task completion?* These are the individual physical, psychological, and background characteristics which are necessary for successful job performance.

Table 1

Task Description Frameworks

(after Hackman, 1969)

the *task qua task* approach is unsuitable because an almost infinite number of potential stimuli and task dimensions exist which makes it difficult to identify which characteristics should be used to define the task.

Hackman's (1969) definition of task is built on the work by Gagné (1964) on *external problem situations.* External problem situations include three components: stimuli (i.e., the task objects and components), instructions (i.e., designed to define objectives, rules, contexts, and processes), and verbal directions (i.e., designed to direct subjects to the stimuli and instructions). Hackman's definition of task is as follows:

> *A task may be assigned to a person (or group) by an external agent or may be self-generated. It consists of a stimulus complex and a set of instructions which specify what is to be done vis a vis the stimuli. The instructions indicate what operations are to be performed by the subject(s) with respect to the stimuli and/or what goal is to be achieved* (p.113).

The three important components of this definition are 1) the stimuli present in the task, 2) the instructions about operations, and 3) the instructions about goals. From this conceptualization, combined with the notion that individuals will redefine tasks, Hackman proposes a framework for analyzing how individuals process tasks (see Figure 1). This framework attempts to map the 1) inputs which are brought into a task scenario (e.g., the task stimuli, instructions, individual characteristics), 2) the redefinition process (individual interpretation of the task), 3) the development of strategies and tactics for completing the task, 4) execution of the task, and 5) the impact task execution on outcomes, perceptions, and learning. The important components of this framework will be discussed in greater depth in Section 2.5.1 where this framework will be adapted to tasks in the context of groups.

UNITARY TASKS:	DETERMINANT(S) OF GROUP PRODUCTIVITY
Disjunctive	*PROCESS:* Optimally choosing the most productive member's input as the group's sole product
Conjunctive	*RESOURCE:* The group's product is limited to the contribution of the least proficient member
Additive	*RESOURCE/PROCESS:* The group's product is an equally weighted sum of the member's contributions
Discretionary	*PROCESS:* The group can chose how to weight the contributions of its members in determining the group's product; (determinant is choosing an optimal weighting scheme)

DIVISIBLE TASKS:	DETERMINANT(S) OF GROUP PRODUCTIVITY
Self-matching/ Specified sub-tasks	*PROCESS:* Optimally matching sub-task requirements to the most proficient member
Self-matching/ Unspecified sub-tasks	*PROCESS:* Optimally identifying sub-tasks and matching those sub-tasks to the most proficient member
Specified matching Specified sub-tasks	*PROCESS:* Appropriateness of the role assignments and the adequacy with which members perform their assigned role
Organizational decisions (unspecified matching/sub-tasks)	*PROCESS:* Appropriateness of the self-selected group organizing process to the task

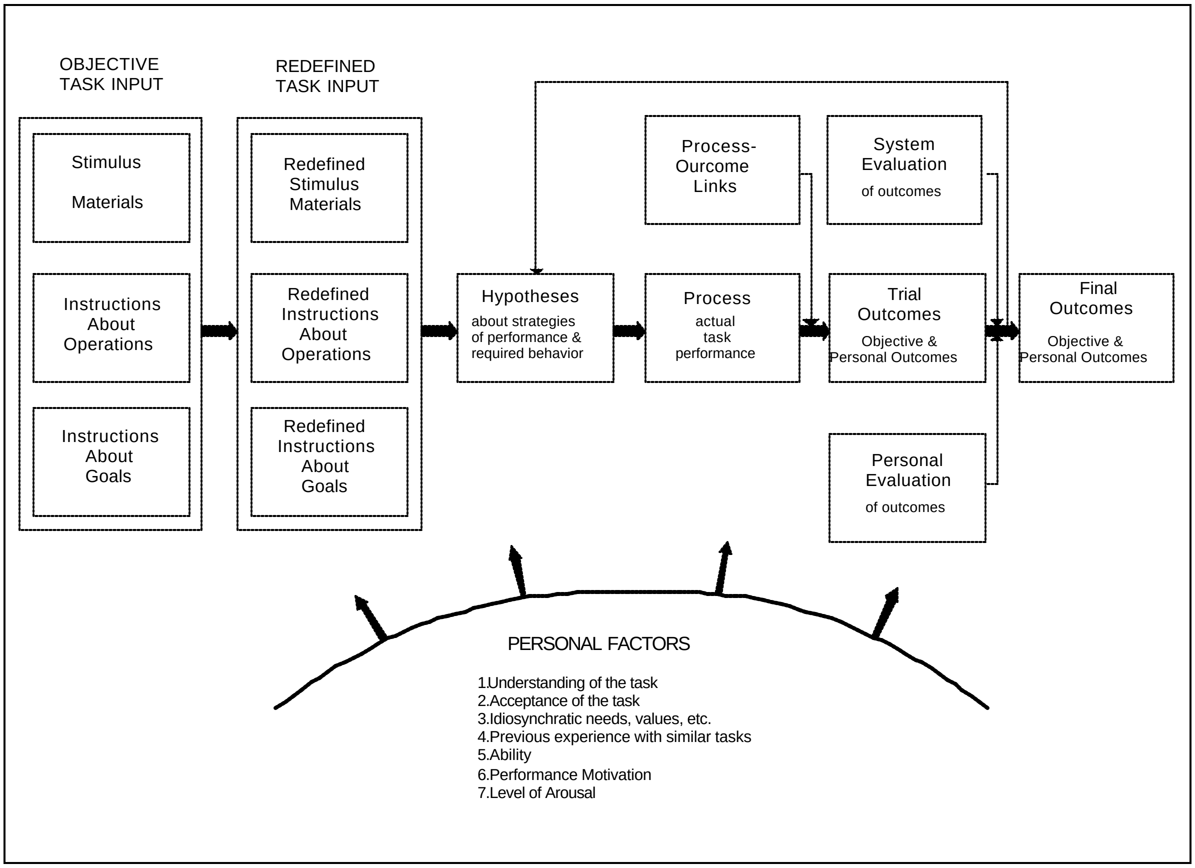

Figure 1
Hackman's Task Framework
(after Hackman, 1969)

In addition to the task description and task framework already cited, Hackman and colleagues also proposed a task typology (Hackman, 1968; Hackman, Jones, & McGrath; Hackman & Morris, 1975). This typology includes three task types: production tasks, which "require the production and presentation of ideas or images" (i.e., idea generation tasks); discussion tasks, which "require an evaluation of issues;" and problem-solving tasks, which "require a specification of a course of action to be followed to resolve some problem" (i.e., planning). Hackman (1968) examined tasks in each of these categories and identified six "descriptive" dimensions (action orientation, length, originality, quality of presentation, optimism, and issue involvement) and two "evaluative" dimensions (performance adequacy and judged product creativity) that he used to link task type to the group's task outputs. Likewise, Morris (1966) used the same data as Hackman, plus a sixteen-category coding system, to examine the influence these task types to the interaction process undertaken by these groups.

Steiner

Steiner (1972) viewed task as one of the key determinants of a group's productivity. His classifications of task focused on the outcome that was to be accomplished and the task imposed constraints that governed the means of accomplishing the outcome. A summary of Steiner's task typology is presented in Table 2.

This view of group tasks distinguishes between unitary tasks, where mutual assistance is infeasible, and divisible tasks that can be achieved through a division of labor. Steiner takes a normative view in which tasks are extensively described in terms of maximizing and optimizing the group's product. A group's maximum productivity is referred to as its potential productivity. This potential productivity represents the most effective use of the group's resources (e.g., member knowledge, skills, coordination, etc.). According to Steiner, however, a group's actual productivity may be less than its potential productivity because of faulty processes:

Actual Productivity = Potential productivity - Losses due to faulty processes

Processes are the "actual steps taken by an individual or group when confronted by a task," (p. 8). This view of group performance and task asserts that a group's performance is contingent on 1) the group's resources and 2) the process of martialing those resources to address the task. Table 2 also lists Steiner's key determinant(s) (resource, process, or both) of productivity for each type of task.

QUADRANT 1	**GENERATE**
Type 1	***Planning Tasks****:* Generating plans; Key notion: Action-oriented plan
Type 2	***Creativity Tasks****:* Generating ideas; Key notion: Creativity
QUADRANT 2	**CHOOSE**
Type 3	***Intellective Tasks:*** Solving problems with a correct answer; Key notion: Correct Answer
Type 4	***Decision-making Tasks:*** Dealing with tasks for which the preferred or agreed upon answer is the correct one; Key notion: Preferred answer
QUADRANT 3	**NEGOTIATE**
Type 5	***Cognitive Conflict Tasks:*** Resolving conflicts of viewpoint; Key notion: Resolving policy conflicts
Type 6	***Mixed-Motive Tasks:*** Resolving conflicts of motive-interest; Key notion: Resolving pay-off conflicts
QUADRANT 4	**EXECUTE**
Type 7	***Contests/Battles:*** Resolving conflicts of power; competing for victory; Key notion: Winning
Type 8	***Performances:*** Psychomotor tasks performed against objective standards; Key notion: Excelling

Table 2

Description of McGrath's Task Categories

Experiments conducted by Herschel (1991) and Hall and Watson (1970) lend some support for the actual productivity equation in the domain of additive tasks with objectively correct solutions. Herschel found that the resources available in the group were an important moderator of a group's decision quality. Hall and Watson reported that the process the group used to integrate its member's resources significantly moderated the group's decision quality.

Hall and Watson, however, also reported that some groups achieved results that were synergistic, or superior to the inputs of the most correct individual input. These group results appear to be superior to the simple summation of the collective individual resources that were available to the group. Such synergies are troublesome to the actual productivity equation because they blur the equation's distinction between the potential productivity, defined by Steiner (1972) as the adequacy of resources, and the losses due to faulty process. A group can only achieve its synergistic potential through an interaction process. A revised actual productivity equation might more accurately depict the process nature of synergies:

Actual Productivity = Potential productivity - Losses due to faulty process + Gains from synergistic interaction

A more extended view of the actual productivity equation that accounts for such synergies is described in Nunamaker et al (1991).

Laughlin

Laughlin (1980) and colleagues (Davis, Laughlin, & Komorita, 1976) have formulated a typology of tasks which classifies tasks based both on the activities that groups are undertaking as well as the relationship between the actors. For instance, they distinguish between tasks that are carried out by cooperating groups and those conducted by groups which are competing (i.e., mixed-motive groups). For cooperating groups, they distinguish between *intellective* and *decision-making* tasks. Intellective tasks possess a demonstrably correct solution (i.e., the solution can be measured and evaluated in terms of its correctness) while decision-making tasks involve the development of solutions which are not demonstrably correct (i.e., an objective measure of correctness is not available and preference among alternatives is a matter of individual or subjective assessments). In summary then, an intellective task requires that the group attempt to discover the correct solution while a decision-making task requires that group members align individual preferences to reach an agreement.

Tasks which are performed by mixed-motive groups are split into several categories. For instance, a distinction is drawn between bargaining tasks and negotiation tasks with the former involving an attempt to resolve differences related to an individual issue or concept and the latter involving a more complex process of resolving differences related to multiple issues. Other mixed-motive tasks include those which involve coalition formation and those which might be called prisoner dilemma-type problems. Tasks that involve coalition formation are, for example, often structured to examine how differential payoffs for various members of a group influence the development of subgroups. Prisoner dilemma problems involve a class of dilemma problems where participants are given, either explicitly or implicitly, a pay-off matrix for either competing or cooperating with other participants.

McGrath's Task Circumplex

McGrath (1984) proposed what he termed a Task Circumplex by integrating the work of Hackman and Morris (1975, 1978), Laughlin (1980), Shaw (1973), Davis (1980), and others into a conceptually and visually elegant framework for classifying group tasks (Figure 2).

Hackman (1968) and Hackman and Morris (1975, 1978) identified *production* (generate alternatives), *discussion* (dealing with issues), and *problem-solving* (generating plans for action) task types based on the behavioral and performance processes required to complete the task (i.e., using the *task as behavior requirement* framework). McGrath built on Hackman's observations and described four general processes (depicted as quadrants): *Generate, Choose, Negotiate*, and *Execute*. Within these general processes he incorporated more specific sub-tasks based on the *task qua task* framework (see Table 2). For example, the model includes Laughlin's (1980) distinction between *intellective* tasks, which have a demonstrably correct answer, and *decision-making* tasks

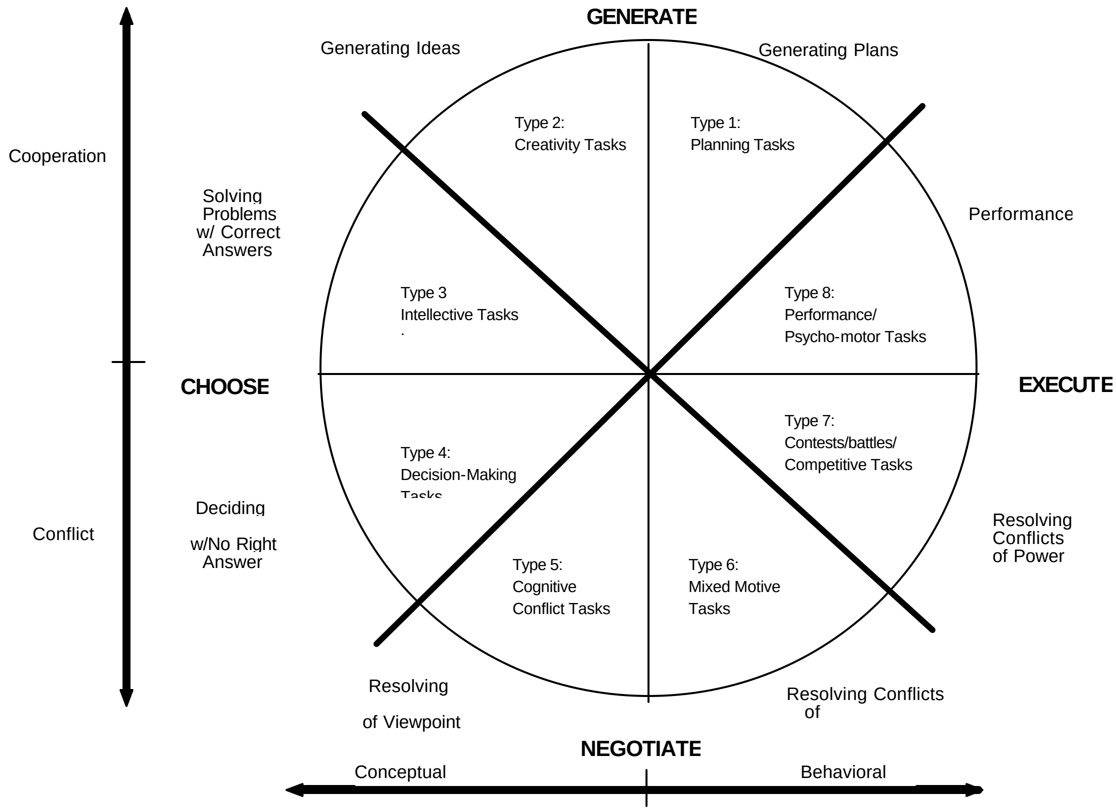

Figure 2
The Task Circumplex
(McGrath, 1984)

which have no correct answer but rely on group consensus.

McGrath designed the Task Circumplex categories to be 1) mutually exclusive between categories, 2) collectively exhaustive, 3) logically related, and 4) useful for comparing similarities and differences of various tasks used in group research. The circumplex is divided on two dimensions: the horizontal axis defines the conceptual/behavioral dimension while the vertical axis defines tasks in terms of conflict/cooperation. These axes are defined using the *task as behavior description* framework since these axes define, at least in part, behaviors which are likely to be produced by the tasks which project on these behavioral dimensions. An important limitation of the circumplex is that it does not provide a means for objectively measuring the degree to which tasks in each wedge of the circumplex differ both from tasks within the same category and also in other categories.

Wood

Wood (1986) presents a general theoretical framework which can be used to derive three dimensions of task complexity. The framework is designed in the context of individual task performance but can be adapted to group tasks. As with Hackman (1969), Wood adopts the *tasks as behavior requirements* framework for physical and motor skill tasks for the same reasons cited by Hackman (1969; p. 111). In addition, however, he also builds his framework on the *task qua task* framework for judgement and inferential tasks since specific task stimuli represent important task characteristics that can be used to classify tasks. The resulting framework posits that all tasks contain three components: 1) products, 2) (required) acts, and 3) information cues. Products are the measurable results of task related acts which can be used to identify and differentiate tasks and which set the requirements for the behaviors needed for task performance. Acts are patterns of behavior which have some identifiable purpose or direction and which form "the basic unit of behavioral requirements" (Wood, 1986; p.65). *Required* acts represent basic task components (required for task completion) and are independent of an individual task performer. Information cues are components of information about task stimuli attributes which task performers can use to make the judgements (i.e., conscious discriminations) required for task completion.

Acts and information cues represent task inputs and since these characteristics vary from one task to another, Wood suggests that the construct of task complexity may represent a useful means for differentiating tasks (Wood, 1986; p.66). Three distinct types of task complexity are defined in Wood's framework: *component complexity*, *coordinative complexity*, and *dynamic complexity*. Component complexity is defined as 1) the number of distinct acts and 2) the number of distinct information cues that must be processed for task completion. Wood notes that the knowledge and skill requirements resulting from component complexity are moderated by *component redundancy* (i.e., the degree of overlap among demands imposed by different task inputs). Total component complexity is defined to be a function of the number of distinct acts required for task completion, the number of sub-tasks present in the task, and the number of information cues that need to be processed. The larger the number of each of these components and the lower the component redundancy for any act or cue, the greater the component complexity of the task.

Coordinative complexity is defined as "the form and strength of the relationships between information cues, acts, and products, as well as the sequencing of inputs" (Wood, 1986; p. 68). This component of task complexity encompasses issues such as the timing and sequencing of acts, the required frequency of acts, the required intensity of acts, and location requirements. Total coordinative complexity is defined to be a function of the number of *turning points* (i.e., non-linear sequences in the structure) in the relationship between task inputs and the task product. Coordinative complexity will be lower when the task product is a *simple linear function* of the task inputs. As more interactions in sequencing, timing, intensity, and in the frequency of acts are required, the greater becomes the coordinative complexity.

Dynamic complexity is defined as the complexity which results from changes in the relationships between task inputs and products. Changes in the required set of acts and information cues or in the relationships between inputs and products can change the required skills and knowledge needed for completing the task. Dynamic complexity will be a function of the stability of the task input-product relationship and will be larger for tasks that are performed over longer periods of time or which are relatively unique (Wood, 1986; p. 73).

Because of interactions between the different types of complexity, total task complexity cannot be precisely stated as a simple linear function of the three types of complexity. Further, as defined by Wood, the task complexity construct applies to individuals rather than groups (Wood, 1986; p. 66). However, we conclude that since the model of task complexity is built on the *task as behavior requirements* and *task qua task* frameworks (frameworks which are independent of the task performers), that the task complexity construct can be applied to group tasks as well. The important distinction that must be made in applying this model to groups is that although total complexity will not change in a group context (since this is inherent to the task), the average perceived complexity (i.e., the complexity per individual) will vary as the number and skill levels of group members vary. Figure 3 portrays our expectations regarding how the average perceived complexity varies with increasing group sizes. We expect that as group size increases, the average perceived component and dynamic complexities should decrease while the average perceived coordinative complexity should increase. We also expect that these relationships will be influenced by computer support.

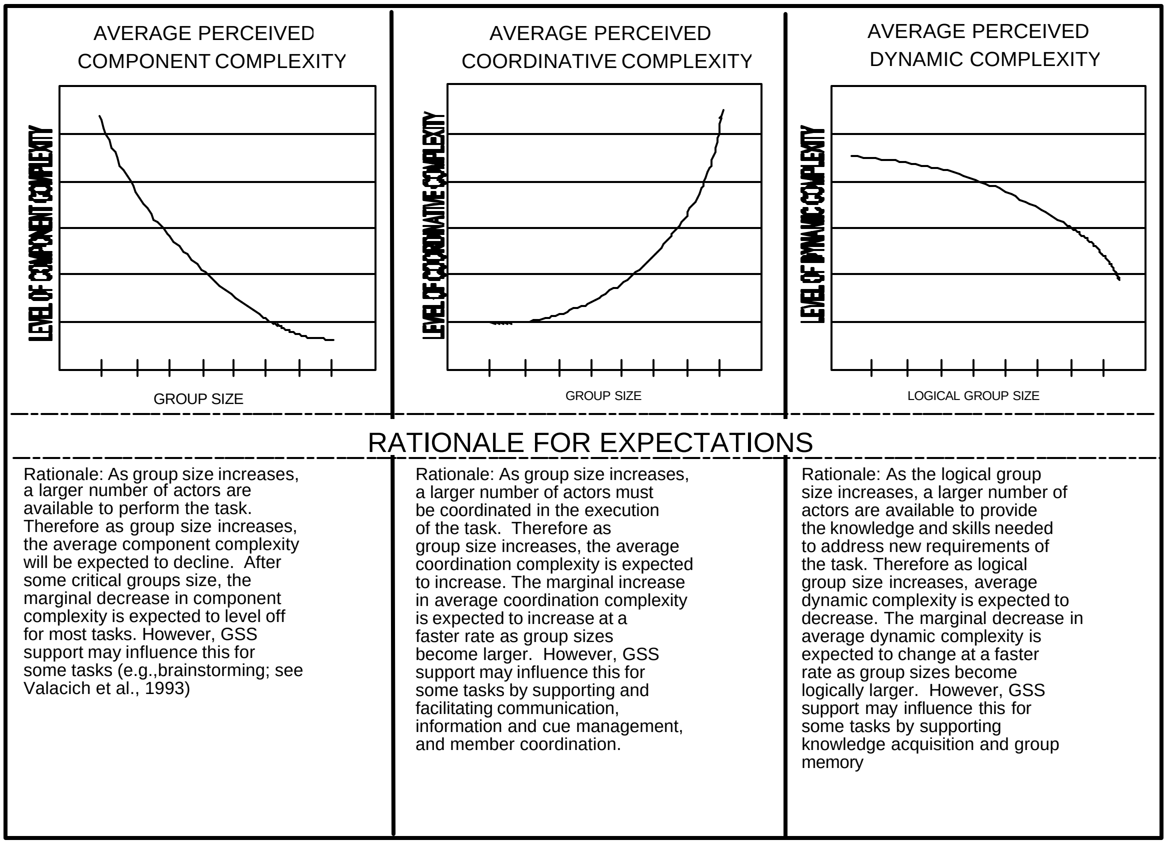

Figure 3: Expected Relationship of Task Complexity for Changing Group Sizes

Stasser

A task with an asymmetrical distribution of case-relevant information is called a *hidden profile* task. Stasser (1992) defined a hidden profile scenario as follows:

> *"A hidden profile exists when the superiority of one decision alternative over others is masked because each member is aware of only one part of its supporting information, but the group, by pooling its information, can reveal to all the superior option"* (p. 49).

Most hidden profile tasks are represent a type of conjunctive task since the success of the group is dependent on the contributions of the individual member who is least likely to share information with the group. In other words, hidden profile tasks are structured so that each group member does not receive the same information and the information that each member does receive is not adequate by itself to optimally address the problem. However, collectively the group has enough information to find the optimum solution. Therefore, hidden profile tasks have the potential to increase the logical size of groups within laboratory environments. In addition, inclusion of an asymmetrical distribution of information in the group adds a new dimension of complexity to experimental tasks because individual group members must not only process the task materials that are shared among the groups participants, but they must also successfully communicate unshared information via verbal or technologically-enabled (e.g., GSS) communication channels.

Hidden profile tasks have the potential to address some of the important "disconnects" between laboratory experiments and field CSCW research that have been noted by several authors (e.g., Chidambaram, 1989; Dennis, Easton, Easton, George, & Nunamaker, 1990; Dennis & Gallupe, 1993; Dennis et al., 1991; Mennecke et al., 1992a, 1992b). Specifically, these tasks provide experimenters with a way to manipulate the logical size of the experimental group. Nunamaker, Vogel, & Konsynski (1989) note that:

> *"A physically large group from a common culture ... may have a high degree of overlapping domain knowledge that results in the group being logically small. Conversely, a physically small multi-cultural group exhibits characteristics of a much larger group because its members have multiple and often conflicting perspectives, points of view, diverse knowledge domains, and opinions that make it logically large"* (p.147).

In many organizational group meetings, members often come from different disciplines and units from within the organization. The very reason that these groups meet is to bring together individuals with a variety of skills and domain knowledge to address a task or project. Therefore members of these groups will often possess different conceptions of the problem or task and they also may view the task from diverse perspectives. Nunamaker et al. (1989) and Dennis et al. (1991) suggest that many, if not most, field studies have probably looked at groups which are much larger in logical size than the typical experimental groups of comparable physical size. This difference is made more pronounced by the fact that experimental subjects in the laboratory generally receive tasks that are "neatly packaged and small in scope" (Dennis et al., 1991; p. 116) with the same instructions and information presented to each participant. The logical size of experimental groups can be increased by the use of hidden profile tasks which may help to extend the generalizability of experimental research. This is potentially one step towards meeting the challenge posed by Dennis et al. (1991) to "model the real world ... as closely as possible, in order to maximize the ability to generalize findings" (p. 125) to organizational contexts.

A Synthesis

Hackman's task processing model (Hackman, 1969) suggests that individuals will redefine tasks through interpretation and reinterpretation into their own framework and mental system. This redefinition process becomes important in experimental research since the way that redefinition occurs will depend on the characteristics of the subjects. Since this redefinition process has the potential to substantively influence task outputs, an understanding of how individuals process tasks within groups would be helpful for academics and practitioners alike. In this section we propose a model which is designed to improve our understanding of how task, individual, and group level variables influence how groups process tasks. Furthermore, we also propose a revised task classification system which incorporates ideas from McGrath's Task Circumplex and Wood's notion of task complexity.

A Model of Group Task ProcessingA Model of Group Task ProcessingA Model of Group Task ProcessingA Model of Group Task ProcessingA Model of Group Task Processing

The task processing framework we propose is adapted from Hackman's model (Hackman, 1969) of individual task processing and our own observations of subjects engaged in experimental tasks (Figure 4). As with Hackman's model, we suggest that tasks fundamentally consist of three components: the task stimuli, instructions about operations, and instructions about goals.

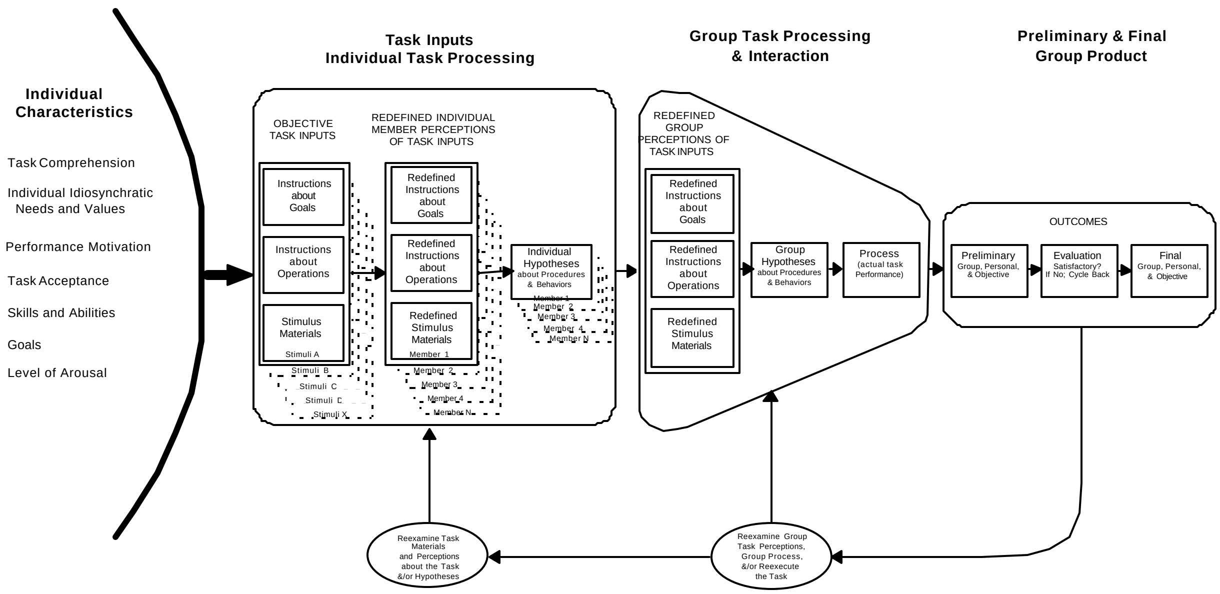

Figure 4: Framework of Task Redefinition and Group Task Processing (*after Mennecke & Wheeler, 1993)*

We expect that individual group members will redefine the task and that they will individually develop hypotheses about how to accomplish the task objectives. In this context, a task becomes what the group as a whole and individuals uniquely perceive and agree that it should be. As Hackman noted: *"Since the information included in the objective statement of task must be perceived and coded by the subject before it becomes useful to him, all of the factors which affect the dynamics of perceptions (e.g., needs, values etc.) potentially will contribute to task redefinition"* (Hackman, 1969; p.119). Hackman (1969) further points out that four factors are likely to be important in the redefinition process: a) the degree to which the individual task performer *understands* the task, b) the degree to which the individual *accepts* the task and is willing to cooperate with its demands, c) the *idiosyncratic needs and values* of the individual, and d) the impact of *previous experiences* with similar tasks. According to Hackman, individual level variables have a significant potential to effect task processing. For instance, individual characteristics such as a person's need for cognition (Petty & Cacioppo, 1986) are likely to influence the mental energy that task performers exert in the process of task completion. In addition, an individual's preference for procedural order (Putnam, 1979) is likely to influence the hypotheses that are formulated at an individual level about methods for completing the task. These individual level considerations are included as inputs to the meeting process and are diagrammed in the model using a layered appearance in order to represent multiple group-member perspectives. In addition, we also portray the objective task inputs in a layered manner to represent 1) multiple roles (i.e., asymmetry of information), 2) multiple instructions about goals which might be given to the group (e.g., mixed-motive negotiation tasks), and 3) multiple instructions about operations which might be given to the group (e.g., tasks where the heuristic given to the group is manipulated).

These multiple perspectives represent the inputs which are brought into the meeting and they are used to moderate the group's consensus view of the task stimuli, the instructions about goals, the instructions about operations, and the hypotheses about completing the task. This group consensus view of the task components will be defined and, perhaps, redefined through on-going group interaction and discussion as the group endeavors to execute the task. In a group context, the redefinition process is made even more complex because of the perceptual issues associated with successful and accurate communication between individuals. In addition, several group level and environmental variables will also become important. For instance, factors such as the group's history, the presence or absence of leadership, and the depth and breadth of experience and knowledge present in the group can significantly influence which group member's task definition becomes the focus of the group's efforts. Also, variables such as the presence or absence of imposed heuristics or computer support and the experience which group members have in solving similar tasks can influence the hypotheses for solving the task which the group develops.

Finally, Hackman (1969) suggests that when individuals generate an outcome they will evaluate whether the outcome has satisfied the individual and objective criteria for adequacy. Our model includes these considerations, plus we have included group level concerns about task outcomes (e.g., potential implications of the outcomes on all or most group members). The model predicts that if results are unsatisfactory and the group has the time and motivation to do so, then members will cycle back to either reexamine the inputs (e.g., the task stimuli: i.e., they will reread the case) and then reprocess the task or they will attempt to reprocess the task directly (e.g., redefine the task or re-perform the task). At this stage, issues such as the valance of potential solutions (i.e., Valance Theory; Hoffman, 1979), the presence of real or perceived time constraints (Gersick, 1988, 1989), and the presence or absence of intrinsic and/or extrinsic sources of motivation can influence whether groups expend the effort to cycle back to reprocess the task.

This model represents a concise framework for examining how individual level task processing can be integrated within a group context. An important contribution of this model is the notion that tasks will be reprocessed both at the individual level and at the group level. This review and the model of group task processing illustrate the complexity inherent in interpreting the behaviors and outcomes that groups exhibit while processing experimental tasks.

The Task Circumplexity

The comments made by Hackman (1969) and by Wood (1986) related to task descriptions suggest that a task typology should take account of task characteristics related to both task qua task and task as behavior requirements descriptions. Both the Task Circumplex proposed by McGrath (1984) and the model of task complexity proposed by Wood (1986) incorporate these constructs, therefore both of these models are built on theoretically sound foundations. McGrath's model is conceptually attractive and it has been widely used by small group researchers. Much of the reason for this popularity probably comes from the simplicity of the model as well as the fact that McGrath successfully integrated and wove together several of the earlier task typologies. McGrath's model, however, does not provide a mechanism for quantitatively distinguishing between tasks both across and within each task category. Wood's model, on the other hand, offers much more precision for distinguishing between different tasks. Unlike the Task Circumplex, however, the model of task complexity does not incorporate the type of task categories that are included in the circumplex -- categories which are both useful and conceptually attractive.

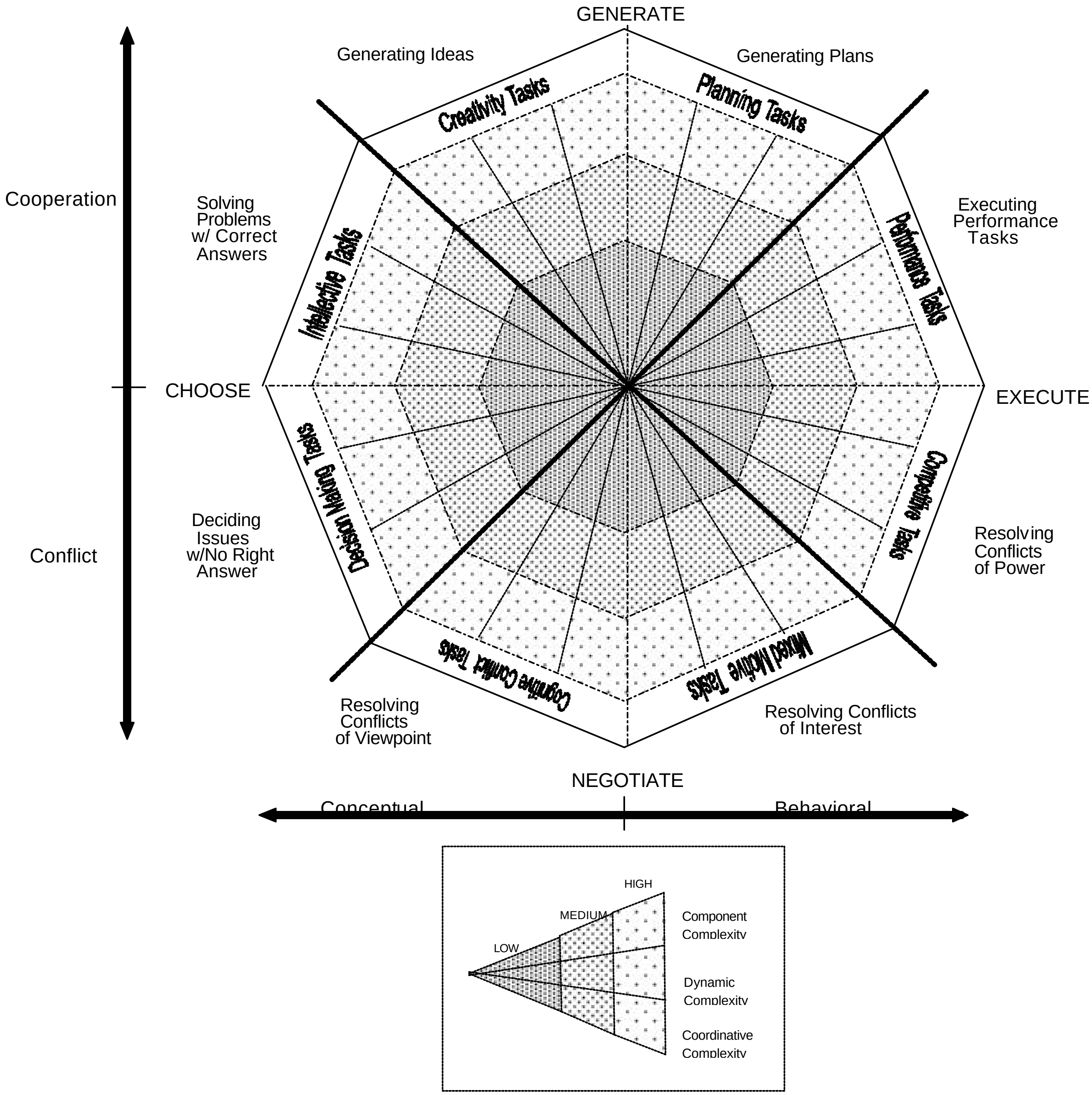

Figure 4

The Task Circumplexity Model

adapted from McGrath (1984)

To capitalize on the benefits of each of these models while addressing their shortcomings, we propose a task model that combines features of each (see Figure 5). This model incorporates the categories from the Task Circumplex and combines these with the complexity dimensions from Wood's task complexity model. Each task is first classified into a category and then rated based on its total complexity score. The same procedures for rating tasks on the three task complexity dimensions as proposed by Wood (1986) are used in our model. The resulting framework is intended to provide a more precise nomenclature for classifying tasks by providing both a categorical system and a quantifiable scoring system. The major drawback of this approach is that it requires a greater degree of effort in classifying tasks since the process of evaluating task complexity is not trivial. Nevertheless, we feel that this approach will help to tighten experimental research related to tasks by providing a system for more precisely classifying tasks and making meaningful comparisons between experiments.

Summary

We have reviewed several task typologies and systems for describing and defining tasks. Although many of these typologies are quite diverse, there are also many similarities between several of these systems. A consistent theme found among several of these typologies is that task definitions should not rely solely on objective characteristics of the task, but also on issues associated with the context and the group. This is consistent with the observation made by McGrath and Altman (1966) when they noted that "*task is an artificial construct. What is 'task' and what is 'group' tend to shade together in many specific instances.*" Furthermore, this review points to the idea that task must be considered to be a fundamental construct in experimental examinations of groups. As Hackman (1969) pointed out,

> "*These considerations suggest that tasks to be used in behavioral research should no longer be considered merely 'something for the subjects to do' while other phenomenon are being studied.*" (p.123)

We are hopeful that this review will help to raise the consciousness of the group research community to the importance of selecting the right task.

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Appendix B

A *Library* of Experimental Research Tasks

Introduction to the Experimental Tasks

We have compiled this set of experimental tasks as a resource for researchers. Due to space limitations, however, we have only included the tasks and not the solutions or other comments from the authors. We have included the citation for each task (or the author if no citation is available). The tasks are listed in alphabetical order based on the authors' names. If you wish to use one of these tasks or if you need additional information or assistance, we suggest that you contact the authors or refer to the citations. We are greatly indebted to those authors and other individuals who provided us with assistance in compiling the tasks that are included in this report.

All tasks are posted to the IS World Research Tasks Repository at

http://wheeler.kelley.indiana.edu/isworld.