

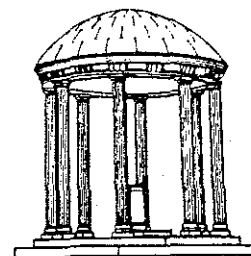
The Application of Modes of Activity
to Group Meetings: A Case Study

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The Application of *Modes of Activity* to Group Meetings: A Case Study

by

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ABSTRACT

A team of researchers at the University of North Carolina is building a computer system to help groups collaborate more effectively. To guide their design, they plan to observe groups collaborating both with and without using existing computer tools. In the initial description of the project, the researchers discuss a concept they call a *mode of activity*. The basic idea is that groups engage in different kinds of activity at different stages of a project in order to accomplish a particular task. They hope to use this concept to help them characterize the behavior of groups in terms of the products they develop and the processes they use to do so. They then plan to build a computer system that includes different user interface modes that correspond with some or all of the observed modes of activity for groups. The goal of this masters project is to determine if the concept of modes in its preliminary form can be applied to groups in a useful manner. To this end, I conducted a case study of the meetings of a group collaborating on an intellectual project. Through my study I concluded that the *mode of activity* concept is useful both for understanding and classifying the behavior of groups in meetings.

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Introduction

As conceptual projects become larger, often no one individual has all of the expertise or all of the time needed to carry out the project alone. To solve these problems, groups are often formed whose members have the different kinds of knowledge and skills required, and whose collective efforts can complete the task in a shorter period of time. However, as groups become larger, the proportion of time members spend actually working on the task versus communicating with one another and carrying on the activities of the group, per se, decreases. The problem is aggravated if the individuals working together are in different geographic locations. To overcome these problems, we need new tools to augment the collaboration process.

A team of researchers at the University of North Carolina is beginning a project that will address these problems. They propose to build a computer system to help groups collaborate more effectively by helping them manage the different kinds of information products developed by a project, such as documents, diagrams, and computer code. They will begin by considering how groups collaborate both with and without using existing computer tools. Their study of conventional collaboration will, in turn, guide them as they design, build, and refine the collaboration support system they plan to build.

In the initial description of their project, the UNC researchers discuss a concept they call a *mode of activity*. The basic idea is that groups engage in different kinds of activity at different

stages of a project in order to accomplish a particular task. More specifically, they consider a mode to be a particular configuration of goals, products that mark the achievement of a goal, specific processes used to produce the product, and constraints or rules that limit or define their behavior. The researchers hope to develop this concept in more detail and to use it to help them characterize and understand the intellectual behavior of groups by analyzing it in terms of these four factors. The goal of this masters project is to determine if this concept of modes in its preliminary form can be applied to group meetings in a useful manner.

I carried out a case study over a two-month period during which I observed five meetings of the UNC Collaboration Project team. From these observations, I characterized the activities of the group in terms of the modes concept. The remainder of this paper describes that study and includes the following discussions:

- background and definition of *modes of activity* concept
- summary discussion of the modes of activity observed
- background for the group observed
- descriptions of five meetings of the group
- conclusion.

Background

The UNC project's goal in studying groups collaborating on conceptual tasks is to determine how groups carry out their intellectual activities. Although there have been many previous studies of groups, most have focused on individuals as they behave in the context of a group or on the interaction among group members, rather than on the group as a whole [Ancona, 1987]. One line of prior research that is relevant for understanding groups' conceptual behavior is that concerned with "task typologies" [McGrath, 1984].

A task typology can be defined as "a set of categories or classes into which group tasks can be sorted, more or less exclusively" [Shaw, 1981]. These typologies are used to classify group behaviors by identifying and labelling the particular task [Swinth & Tuggle, 1971; Morris, 1966; McGrath, 1984]. In research focusing on different aspects of behavior in a group, such as leadership within groups [Carter, Haythrn, & Howell, 1950], the effects of group size on behavior [Steiner, 1972], etc., these typologies have been by-products of the study, rather than its principal focus. Thus, different task typologies have been defined to suit specific research goals. Nevertheless, task classification systems may lend insight to our exploration of group processes and help us to identify the different modes groups engage. Toward these ends, the following discussion reviews several definitions of the term *task* and then identifies distinctions among several task typologies that have been used widely.

Steiner's definition of tasks has been widely cited and seems to apply to all of the typologies reviewed below:

[a task is] work that must be done in order to accomplish some purpose. It refers to a set of behaviors that must be performed or to the actions that someone is required to take. A more useful conception of task, though, focuses upon the end that is to be accomplished and the rules and constraints that govern the manner in which that end can be achieved [Steiner, 1972].

While the basic concept seems to be the same, Shaw has provided a more concise definition: "that which must be done in order for the group to achieve its goal or subgoal" [Nixon, 1979]. Thus, both definitions define tasks by identifying their components. Both emphasize *goal* and *process*, while Steiner also includes *rules* and *constraints*.

One of the most widely cited task classification systems was developed by Bales. His system of interaction process analysis (IPA) "has dominated the field for several decades" [McGrath, 1984]. Bales described that problem-solving groups are concerned with two types of activities: *instrumental* activities dealing with the group's task; and *expressive* activities, associated with the interrelationships of group members [McGrath, 1984]. Bales divided these two types of activities into twelve categories [Bales, 1970] that can be used by an observer to characterize group behavior by focusing on group interaction, such as who does what to whom in the group in a time-ordered sequence [Luft, 1984]. Bales' system includes categories such as "shows solidarity", "shows tension", "disagrees", and "gives information." For example, Bales says that the "gives information" category includes interactions where information is

neutral, factual in form (though not necessarily true), based on perception or direct experience of potentially public events or objects, and hence testable. ... Any statement too vague in principle to be tested is not classified as giving information, but, usually, as giving opinion [Bales, 1970].

Determining that information is neutral or factual is, of course, a matter of interpretation, thus, Bales' method is impressionistic. In fact, McGrath says that observers who want to use Bales' IPA system effectively must be highly trained and skilled [McGrath, 1984]. One of the goals for the UNC group is to develop guidelines for observing groups to help the observer make more analytic, and thus less impressionistic, characterizations of group behavior. They hope that the specification of a mode of activity as a unique combination of *four* constituent components -goals, products, processes, and constraints- will help in this effort.

Although other task classification systems have not proven as popular as Bales', several of these concentrate on the *products* generated by the group and, thus, can contribute to the UNC study. For instance, in his study of group productivity, Hackman limited the set of tasks to be considered to those which required the group to produce a written product. Hackman identified three types of tasks:

(a) tasks calling for the production of ideas, images, or arrangements, called production tasks; (b) tasks calling for a discussion of values or issues, usually with a requirement of group consensus, called discussion tasks; and (c) tasks requiring that a solution to a specific problem be worked out, usually within a set of constraints, called problem-solving tasks [Hackman, 1968].

Hackman specified eight properties that he used to classify the products generated by the groups and found that these "characteristics of group products are strongly affected by the type of task with which groups work." For example, "problem-solving tasks were characterized by high action orientation, production tasks by high originality, and discussion tasks by high issue involvement" [Hackman, 1968].

It seems that Hackman's study could be generalized to include intellectual products of any type. We can reason that because products are strongly affected by the type of task, and particular tasks generate particular kinds of products, then tasks may be somewhat, but not solely, differentiated by the types of products that they produce. Hackman's findings then suggest that the *product* of the task is essential to understanding group activity, but not sufficient.

Steiner's study of group productivity further confirms the value of

focusing on the product generated by a task. Steiner distinguished between tasks that are divisible and those that are unitary. Furthermore, as Steiner described them, "unitary tasks have a single outcome or product, into which the individual contributions of group members must somehow be combined" [McGrath, 1984]. Unitary tasks are specified as *disjunctive* (the group does as well as the best effort), *conjunctive* (the group does only as well as the least effort), or *additive* (the group success is dependent on the sum of individual efforts) [Steiner, 1972]. Steiner identified tasks with a "*permitted process*" and says that "tasks differ with respect to the ways they permit members to combine their individual products." Steiner also described tasks with a *prescribed process* - "a series of acts which, if they occur, permit the group to be maximally effective in the performance of a task." He described *discretionary* tasks as tasks in which the group members decide how they will combine their individual outcomes [Steiner, 1972]. Thus, Steiner's classification depends on how the group members' contributions are combined into the final product [McGrath, 1984]. This model, which was designed for and is especially useful in determining group productivity, may also benefit our research. For instance, a further study might focus on the products generated by groups in terms of their being disjunctive, conjunctive, or additive. These categories may provide useful insights into the types of group processes used to generate products that require different degrees of combined effort from the group.

Morris built yet another task typology that used group products to classify tasks. In his study of the task effects on group interaction, Morris determined that the differences between tasks were most easily understood when they were divided into two types: "production activities" and "process activities" [Morris, 1966]. Production activities are "directed toward the generation

of some group product or output," while process activities "connote a standing still or at least a temporary diversion of immediate concern away from group productivity." Activities such as structuring an answer or proposing specific solutions are examples of production activities, while problem structuring, clarifying, and explaining are examples of process activities. Morris found that "groups working on discussion tasks were characterized by process activities", and "groups working on production tasks were characterized by an emphasis on production activities." In problem-solving tasks, the group used a combination of process and production activities [Morris, 1966].

The UNC study departs from Morris' proposal in that it views every group activity as yielding a product. But, this product may be tangible, or it may be intangible. Because we include intangible products, clearly every activity will generate something, even if it is just a group "understanding" of an issue, a body of "shared knowledge," a common "sense of progress," etc.

In their study of how leadership in groups is affected by task differences, Carter, et. al. did not consider the products of tasks, but rather divided tasks "on the basis of the kinds of activities that groups (or individuals in them) must carry out in order to complete the task" [McGrath, 1984]. Carter, et. al. determined six task types: *reasoning, intellectual construction, clerical, discussion, motor cooperation, and mechanical assembly*. The distinguishing features between these tasks are the "performance processes involved in the tasks, and ... [the] set of behavior requirements on the members" [Carter, Haythorn, & Howell, 1950]. This focus on the processes used to carry out tasks suggests that "processes", as well as "products", are important characteristics of group activities.

Shaw and Laughlin both also conducted studies in which they invented yet other task classification systems. Consequently, these systems provide yet another view of task characteristics. Shaw studied small groups and extracted six properties along which group tasks varied: intellectual vs. manipulative requirements (ratio of mental to motor requirements), task difficulty (amount of effort required), intrinsic interest (degree to which the task was interesting to group members), population familiarity (degree to which members had experience with the task), solution multiplicity (number of correct solutions to the task), and cooperation requirements (degree to which integrated action is required by all group members) [Shaw, 1981; McGrath, 1984]. Laughlin's study "[distinguished] tasks being done by cooperating groups from those being done by competitive and/or mixed-motive groups" [McGrath, 1984]. Laughlin specified that in cooperating groups, there are two types of tasks: 1) intellectual tasks - there is one demonstrable right answer; and 2) decision tasks - the group has to decide what the right answer will be. In inter-personal conflict or mixed-motive groups there are 1) two-person, two-choice tasks; 2) bargaining and negotiation tasks; and 3) coalition formation and resultant reward allocation tasks [McGrath, 1984].

Thus, a number of different task typologies have been developed, each emphasizing different features and each with different labels or classifications. A useful discussion for relating these different systems is McGrath's review of the field [McGrath, 1984], that attempts to provide a comprehensive set of task classifications. Thus, he extracted main ideas from the studies mentioned above, elaborated on them, and placed them into a framework he called "a circumplex model of group task types." The Circumplex Model divides group task activities into the following categories:

- 1) Generate

- a) ideas
 - b) plans
 - 2) Execute
 - a) executing performance tasks
 - b) resolving conflicts of power
 - 3) Negotiate
 - a) resolving conflicts of viewpoint
 - b) resolving conflicts of interest
 - 4) Choose
 - a) deciding issues with no right answer
 - b) solving problems with correct answers
- [McGrath, 1984].

McGrath's system, by virtue of its comprehensiveness, may be useful to the UNC project in verifying that the set of modes of activity they develop has not omitted a recognized kind of behavior. However, like the other task typologies mentioned here, the Circumplex Model is a method of recording information about task *types*, but is less helpful for recognizing *when* the group is engaged in a particular type of activity. What is still needed is help in recognizing exactly when a group has shifted from one kind of task to another. This issue is addressed by the modes of activity theory, described in the next section.

If we step back and draw all of these systems into perspective, we see two major themes. First, either explicitly within stated definition of the term *task* or implicitly in their discussions and classifications, these studies have identified a number of components or factors that make up tasks. Components that have been identified include the goals of the group at a given moment, the different kinds of products it generates, the processes or procedures engaged in by the group, and the constraints or rules that govern the group's behavior or give it a particular color. However, in no single theory that we have seen have all *four* factors been combined. It is the *interdependent* configuration of all four factors that the UNC group has focused on and made the

basis for their definition of mode of activity, discussed below.

Second, a number of researchers have proposed specific classifications or typologies of tasks that they believe are comprehensive. Thus, each system is closed by virtue of the fixed set of activity types it identifies. By contrast, while the concept of mode of activity is viewed as a general construct, the set of behaviors it can be used to describe is open. This is because groups are expected to develop new modes of activity as they invent or use new intellectual tools to solve new kinds of problems, or address new kinds of goals, etc.

Modes of Activity

The UNC group has defined a new construct for analyzing the behavior of groups that they call a *mode of activity*. Historically, that framework was developed by merging concepts from two previous bodies of work: a theory of cognitive modes and activity theory. As the preceding discussion has shown, however, a third relevant body of material can be found in the literature concerned with task analysis. In the sections that follow, the cognitive mode theory and activity theory will be briefly outlined, followed by a discussion of mode of activity; but I also relate mode concepts to the earlier discussion of tasks in several key points.

Cognitive Modes

Many conceptual tasks require several different kinds of thinking. For example, an individual writing a document engages in several different types of activities, which require different ways of thinking. Writers may explore, plan, revise, etc. Smith and Lansman call these different types of thinking *cognitive modes*

[Smith & Lansman, 1987]. In particular, they define a cognitive mode as

an interdependent combination of *goals, products, processes, and constraints*. The *product* of a mode is the symbolization of a concept or relation among concepts. Different cognitive modes provide different options for representing concepts or structures, such as words, diagrams, notes, outlines, and other forms. Thus, different forms prevail in different modes. *Processes* act on products to define them or to transform one form into another. Thus, certain processes are favored in certain modes, while others are de-emphasized or suppressed. The *goal* of a mode represents the individual's intention for engaging that particular way of thinking. While goals are abstract, they are made concrete in a particular product the individual aims to produce. The *constraints* for a mode determine the choices available. Constraints are relaxed or tightened in accord with the individual's large-scale strategies for engaging different modes of thinking for different purposes [Smith et. al., 1990].

Thus, cognitive modes are consistent with the definition of tasks, discussed earlier, in that modes are comprised of four components -goals, products, processes, and rules/constraints. But as also observed, no single theory of tasks has included all four.

As an example of the mode concept, Smith and Lansman compare the *exploratory* and *organizational* modes used by writers.

During exploration, the goal is to externalize ideas, consider different combinations, and to gain a general sense of the information available or missing. Thus, constraints are minimal to encourage creativity and multiple perspectives. The processes that are emphasized are memory recall, associating, relating, and building small component structures. The products generated are, thus, notes, jotings, diagrams, perhaps loose networks of

ideas. During organization, the goal is to plan the actual document to be written; thus, constraints are tightened to produce a logical, coherent organizational plan. That plan is normally a hierarchy or other regular form. And the processes are analyzing, synthesizing, sustained conceptual building, and refinement based on noting consistent/inconsistent relations in the structure. *Exploration-and organization* are, thus distinctly different ways of thinking. And they differ still from other activities such as actual writing and several forms of editing [Smith et. al., 1990].

Labels such as *exploration* and *organization* are reminiscent of those discovered earlier with respect to task typologies. However, the set of mode types is not necessarily closed. But more importantly, modes fit within a larger structure of relationships.

According to Smith and Lansman,

cognitive modes are used strategically. Individuals move from one mode to another in accord with a general procedure they know and use to accomplish a particular intellectual activity. But they also move back and forth among modes--both recursively and iteratively--to solve problems that arise or to take care of new developments, such as the appearance of new information not available earlier. Consequently, this theory of modes and strategies is *not* a stages or waterfall model but rather a dynamic system in which the history of an individual's movement among modes would normally form a network rather than a linear sequence [Smith et. al., 1990].

The UNC team in which Smith and Lansman work has used this concept of cognitive mode as a basis for developing a multi-modal Writing Environment (WE) and for studying writers' cognitive strategies [Smith et. al., 1990]. This system includes four user interface modes that map onto six cognitive modes. Thus, they suggest, WE is a theory-based system that rests on the intellectual

foundation of cognitive modes. They are now testing and refining both theory and system in a series of controlled experiments and studies writers using their system to plan and write documents [Smith et. al., 1986].

Activity Theory

While providing an analytic framework for examining the intellectual behavior of individuals, the theory of cognitive modes described by Smith and Lansman does not take into account the social and cultural influences that affect people working in the real world. To study the behavior of individuals collaborating in a group as well as the group as a whole, we must take into account these social and cultural factors. These issues have been addressed in a separate body of work carried out in the early part of this century by Vygotsky, Leont'ev, and their followers. These Russian psychologists developed a body of ideas now called *activity theory*. Activity theory includes several concepts that may prove useful in understanding the behavior of groups. These include *mediating device*, *higher mental functions*, and *activity*.

For the 'cultural historical school of psychology', culture is essential in the development of human cognition. A group's cultural tradition provides the means, in the form of symbols, to transform lower-level, biologically-based mental functions into *higher mental functions*. Symbols function in the mental world as tools do in the physical world. They become psychological devices for mediating between one's mental states and processes and one's environment. For example, remembering, as made possible by an individual's biologically given mental functions, is a 'lower-level' mental function. However, when people learn to use *mediating devices* ... [such] as tools for remembering, their memory capacity is increased and they have more conscious control over the process. ... Whereas Vygotsky stressed semiotic mediation and the importance of cultural meaning systems in cognition, his student and

colleague, A. N. Leont'ev and subsequent activity theorists, emphasized the idea that cognition is situated in *activity*. Individual cognition always takes place in, and is responsive to, socially created activities. [Smith et. al., 1990].

Merger

The UNC group has combined ideas from these two domains to describe a concept they call *modes of activity* [Smith et. al., 1990]. A mode of activity consists of a particular set of goals, products, processes, and constraints used by a group in carrying out a complex intellectual task. It attempts to characterize the different kinds of intellectual behaviors that take place in a group as different modes of activity, analogous to the different cognitive modes used by individuals. For example, early in a project, many groups go through a form of collective brainstorming in which they try to build a common understanding of their task and an understanding of one another. Later, they may work in pairs or small groups to hammer out a solution to a technical problem. These two activities are very different from one another, in goals, products produced, and the way the group goes about its task (the processes or procedures it uses).

While modes of activity are similar to cognitive modes in that they consist of a combination of goals, products, processes, and constraints, the UNC team believes that they are both more extensive and more complex. As examples of their greater number, groups exchange information and often attempt to persuade one-another. These two activities are not normally engaged by an individual. As an example of greater complexity, the individual members of a group may be in one mode, while subgroups of individuals may be in another mode, and the group as a whole may be in yet another mode. An example of this kind of modal

complexity is seen in meeting #4, described in the Meetings section.

Because we are looking at *groups* of individuals, the different components that constitute a mode of activity will also be more complex than the components for a cognitive mode. Thus, a mode of activity may have more than one goal. For example, as a presentation is given to the group, one goal is to present the information, but there may be an additional goal of persuasion as well. Products generated by a group may be tangible or they may be intangible. A group may produce a tangible product, such as a diagram on a whiteboard or a list of ideas. The group may also produce intangible artifacts such as a shared body of knowledge. Both are "products," but one is less visible than the other. The group may also use several sets of processes in a single mode of activity. For instance, an individual giving a presentation to the group uses a different set of processes than the individuals listening to the presentation. Finally, there may be more constraints imposed on a group than on an individual. For instance, for a group to be orderly, one constraint often imposed is that individuals take turns talking.

The mode of activity construct also borrows from the cognitive mode theory in that it too focuses on the strategies that groups follow in their activities. The cognitive mode theory suggests that a task is divided into smaller sub-goals that must be completed in order to realize a broader goal. Thus, the cognitive mode theory emphasizes that an individual engages in modes purposefully, with a strategy in mind for completing a composite task. The mode of activity construct also assumes that groups will have smaller sub-goals that they must complete in order to achieve some broader goal. And likewise, although a group may not enter modes as purposefully as an individual, they may still engage in a strategic

sequence of activities with the expectation of completing some larger task.

In this way, the modes of activity concept is also similar to Bales' idea that groups go through an "orderly series of phases." Bales described that the task-oriented group goes through an orientation or information gathering phase, then continues to an evaluation of that information, and finally to a control or decision making phase [McGrath, 1984]. Although Bales recognized this strategic pattern in groups, none of the other studies reviewed above were concerned with the *sequence* of activities in which groups engage. Thus, a fundamental difference between these previous studies and the modes of activity concept is that the modes of activity theory is not only concerned with the *classification* of activities, but with the *sequence* of these activities as they are used to complete a broader task. Thus, the mode concept has a broader goal than Bales' in its concern, ultimately, with the rules that account for broad strategic and tactical patterns of modes as they are engaged by groups.

In the case study I conducted, I did not address the strategic use of modes but rather attempted to analyze the activities of a group by focusing on and identifying the goals, products, processes, and constraints that were present in the activity of a group at a given moment. In the section that follows, the methods used are discussed in more detail.

Method

Runkel and McGrath believe that in order to analyze observations of a group, a structure must be imposed on the data that will answer questions pertinent to the study [Runkel & McGrath, 1972]. I imposed the framework of modes of activity on the data that I

collected in my project in order to "filter" my observations so that particular factors were high-lighted. I observed the meetings of a group in an early stage of collaboration and attempted to characterize the group's behavior during their meetings by identifying the various goals, products, processes, and constraints exhibited by the group. I then labeled predominant combinations of these constituent parts as particular modes of activity. The definition of a mode of activity as a unique set of goals, products, processes, and constraints, implies that as one of these component changes, a new mode is encountered. Thus, I considered the group to have switched from one mode of activity to another when a component changed significantly (for example, if a goal or process changed, I reasoned that a modal switch had occurred). Then, I looked closely at events or conditions that caused the group to switch from one mode to another.

Because the modes of activity theory will aid in building a computer system for collaborating groups, it was necessary that the group chosen for my case study be as "natural" as possible. Thus, instead of conducting laboratory experiments with groups, as some of the previous group studies have done (eg. Hackman's study of group products [Hackman, 1968]), my study focused on a group already collaborating on an actual task. I not only chose this group because it was "natural", but also because it was in its infancy and provided a natural starting point for my study. One limitation of this choice was that some members of the group were the same individuals who had developed the mode of activity theory; however, I did not observe behavior that suggested that their theoretical perspective affected their behavior in the group. A second limitation was that I did not observe the behavior of this group or its members outside of their meetings. Since my goal was to test the basic viability of the concept in a limited context of activities over a limited period of time, these and other important considerations must be taken into account in future studies to

further evaluate and refine the modes of activity concept.

Thus, the goal for my project was to determine the basic viability of the modes of activity concept as applied to group meetings. In doing so, I hope to contribute to a process of refinement that will be continued by the UNC research team over the next three years.

Summary of Modes of Activity

Several types of modes of activity emerged from my observations of group meetings. I identified three primary modes of activity and several "sub-modes." In most cases, these modes fit neatly into the proposed framework for modes of activity in that unique sets of goals, processes, products, and constraints could be observed as they occurred throughout the meetings. But, in several specific instances the theory did not work well, thus suggesting the need for further development and refinement.

The most common mode of activity was **discussion**. However, this behavior occurred in different forms which I call "submodes." These included **conflict-resolution** and **brainstorming**.

Presentation was a second predominant mode of activity that occurred during my studies. I suspect that this mode was used often in the meetings I observed because the group was new and required a significant amount of new information from the leaders to provide members with an understanding of the project. The submodes of presentation mode that I saw were **summary** and **demo**.

I also identified a **delegation** mode of activity. This mode was only seen once, briefly, in my studies but because the project work

must be divided up among group members, there will probably be many instances of the delegation mode of activity in the future.

Thus, the modes of activity that I identified are the following:

- **Discussion Mode of Activity**
 - Discussion, in its basic form
 - Conflict-Resolution Sub-mode of Activity
 - Brainstorming Sub-mode of Activity
- **Presentation Mode of Activity**
 - Presentation, in its basic form
 - Summary Sub-mode of Activity
 - Demo Sub-mode of Activity
- **Delegation Mode of Activity**

The following is a matrix of each of these modes and its constituent parts.

	Mode	Goal	Product	Process	Constraint
Discussion	Disc	externalize info	group-level awareness of info	1) dialog 2) analysis	take turns talking
	C-R	externalize info	1) group-level awareness of info 2) resolving a conflict	1) dialog 2) analysis	1) take turns talking 2) one topic addressed 2) subset of group involved 3) different opinions encouraged
	Brain	externalize info	1) group-level awareness of info 2) generating ideas	1) dialog 2) analysis	take turns talking
Presentation	Pres	introduce info	group-level understanding of info	1) teach & inform 2) listen, learn, question, evaluate	one individual controls
	Sum	1) introduce info 2) receive same message	group-level understanding of info	1) teach & inform 2) listen, learn, question, evaluate	1) one individual controls 2) carried out by leader
	Demo	introduce info	group-level understanding of info	1) teach & inform 2) listen, learn, question, evaluate	one individual controls
Deleg	Delg	assign task	understanding of work responsibility	1) delegate, explain 2) listen, evaluate	Senior member delegates

Each is described in more detail below.

The discussion mode of activity was characterized by a particular combination of goals, processes, products, and constraints. The

goal of this mode was to externalize ideas and information. The processes used to meet this goal were dynamic dialog among group members and analysis of ideas by individuals. The product produced by the discussion was a group-level awareness of the information discussed. More specifically, the group often defined a concept (example: ...application *wrappers*) or related existing concepts to one-another (example: the drawings on the whiteboard). The constraints on the discussions were few, but included the restriction that individual group members take turns talking. Once a particular group member (usually the leader) began holding the floor for a long period of time, the group could then be characterized as being in a presentation mode of activity instead of a discussion mode of activity.

The conflict-resolution variation of discussion had the additional and more specific goal of resolving a conflict. In addition, this mode of activity was accompanied by more constraints. For instance, since one particular topic was addressed, the discussion was more focused. In addition, the group of individuals involved was normally a small subset of the whole group. In fact, most often the individuals engaged in dialog were the two who held the opposing opinions that caused the conflict. Another constraint was that each individual was given a chance to voice an opinion, thus different points of view were encouraged.

Brainstorming was the second variation of discussion mode that I observed. This sub-mode had the additional goal of developing ideas in a free-form fashion: hence constraints were few. Since this group was in an early stage of a new project during the time I observed them, many of the discussions I observed were of this brainstorming type.

Throughout the group's discussions, examples were highly

important. For instance, a group member often explained a point using a software application, such as I-Draw or emacs, as an example. Others picked up on the example given and used it throughout the discussion to explain their own points.

Presentation activities were also predominant throughout the group's meetings. The presentation activity was defined by a specific set of characteristics. The goal was to introduce a piece of information to the group. The processes used by the group divided into two sets: the individual presenting the information used processes to teach and inform; the group members listening to the presentation used processes such as listening, learning, questioning, and evaluating. Thus, the individual members of the group and the group as a whole were in slightly different modes of activity. However, for simplicity, I labeled the entire group as being in a presentation mode of activity. The product produced in this mode of activity was a shared understanding of the information presented. One constraint of this mode was that the individual who gave the presentation had control of the floor and the flow of the meeting during the presentation.

In several of the presentation modes that I observed, a general description of the project was presented. During these presentations, an additional goal emerged. This goal was to solicit support for the project. One example of a mode with this additional goal occurred in the first meeting as the project basics were presented. Another example occurred in the last meeting as a prototype computer system was shown. In both of these cases, the presentation mode of activity had an additional requirement that the presentation be appealing to the group members.

I also defined a summary sub-mode as a type of presentation. Like the basic presentation mode of activity, the goal of the summary

mode of activity was to present information to the group. But an additional goal was to insure that the members of the group received the same message from the information summarized. In one summary, there was yet another goal. The presenter of the summary had a chance to emphasize his own views. Another characteristic of this mode was that it was initiated and carried out by a group leader.

Another submode of presentation was the demo submode. This mode had an additional characteristic of being held around a computer terminal or workstation. The setting tended to promote a more informal and relaxed atmosphere. In addition, the hands-on experience by group members with the product being presented gave them a clearer understanding of the system. Thus, the group asked more in-depth questions. Overall, I believe the group came away with a greater and more consistent understanding of the product presented in the demo mode of activity than they would have had from a basic oral presentation.

Delegation was the third type of activity that I identified. The purpose of delegation was to assign a task; thus the product of this mode was an understanding of work responsibility. The individual assigning the task used the processes of delegating and explaining, while the individual receiving the work assignment listened and evaluated. In this case, a senior member of the group was delegating work to a member of the group with less seniority. I assume this would be the case in most instances of this mode, but further observations will be needed to confirm this and other characteristics that I identified in the delegation mode.

Throughout these group meetings I noticed a strategic pattern that developed for switching modes of activity. Often the activity changed from a presentation to a discussion prompted by use of a

mediating device, such as foils on an overhead projector; a document, or the prototype system demonstration. A question or comment from group members prompted a switch to a discussion. As the next piece of information was presented, a switch back into the presentation mode of activity occurred. This cycle repeated itself several times in Meetings #3 and #5. While the concept of mediating devices was used by the UNC researchers for background for their theory, they have not yet included it as an integral part of the mode of activity concept. This seems to be a significant omission.

I observed another scenario in which modal switches occurred systematically. This pattern occurred during a brainstorming session. As an individual presented an idea that he came up with, he presented it while the other group members listened and learned. If this presentation was lengthy, the group could be classified as being in a presentation mode of activity. Oftentimes, discussion of the idea followed the presentation of the idea. Thus, the group slipped into a discussion mode of activity. The group eventually drifted back into the brainstorming type of discussion to generate new ideas. Thus, patterns of behavior could be observed that were larger than individual modes. While the mode of activity theory as currently defined mentions sequences of modes, it may wish to look more closely at patterns such as these to derive specific rules that account for mode switches.

Although the concept of cognitive mode with its four constituent parts was successfully extended to group cognition, several differences arose. For instance, several times, within the same mode, the processes used by the leader (or acting leader at the time) differed from the processes used by the other members of the group. For example, in presentation mode, the processes used by the presenter were very different from those used by the other members of the group. Thus, the presentation mode of activity

contained *two* sets of processes instead of the conventional *one* for a cognitive mode. This issue seems to be one of definition, rather than inconsistency.

Also, in some cases, several goals were present within the same activity. For example, within the presentation mode of activity there were instances where soliciting group support, as well as informing, was a predominant goal. During other presentations, this goal did not exist. Thus, we see that modes of activity have a characterizing goal, but may have other important contributing goals or subgoals as well.

Another difference between individual cognitive modes and group modes of activity was seen in the occasional coincident modes of activity within the group. While an individual probably cannot be in more than one mode at a time, a group can. For instance, the group may be in one mode, but some group members may choose not to participate. An individual may be daydreaming, or thinking of something aside from the task the group is engaging in. Thus, the group mode may not be the sum of the modes for the individuals that comprise it.

A more severe problem occurred in the mode of activity theory as I noticed a difference between demo and presentation modes of activity. I classified these as separate modes (demo mode is a submode of presentation mode), since they appeared to be very different activities. However, the two had the same combination of goals, products, processes, and constraints. According to the definition of mode, two activities that have the same sets of constituent parts should be the same mode of activity. In this case, the difference between the presentation and demo mode of activity seemed to be determined by the use of an operational artifact as a mediating device in one mode but not the other.

Again, this instance suggests the need for more integral use of mediating device in the basic structure of the theory.

In addition to these problems, my study raised several questions. For example, I explained above that the group engaged in cycles of activities. For instance, as individuals were in the brainstorming activity, they externalized the ideas that they generated. If an individual's explanation was *lengthy* enough, I determined that the group was engaged in a presentation mode. The question that arose was "How long is *lengthy*?" In general, how long does a group have to be diverted before they can be classified as having changed activities?

Another question emerged as I considered the element of persuasion present in some of the presentations. In fact, persuasion was a motivating factor on and off in several of the group's activities. Because persuasion was an additional goal, and it is assumed that the group has changed modes when one of the four constituent components changes, perhaps a new mode should have been defined for occasions when persuasion was encountered. Thus, another question arose: "When should a new mode of activity be defined?"

Thus, my study confirmed that the mode of activity concept could be used as a filter through which to view and characterize the behavior of groups during meetings. The focus on specific components - goal, product, process, and constraints - made me more confident of my observations and provided me with data on which to base my judgement. But at the same time, my study showed several specific places where the theory needs further work. These include:

- specifying the four constituents in sufficient detail to uniquely identify a particular mode of activity

- including the mode/submode distinction within the theory
- developing a concept of mode hierarchy that can address situations
 - in which individuals, subgroups, and the group as a whole are all in different modes at the same time
- incorporating mediating devices into the theory and/or definition of mode
- developing rules to account for "mode sequences" and other large-grain patterns of behavior
- describing rules to determine that the group has entered a new mode
- deciding when to create a new mode of activity.

These difficulties do not invalidate the concept of mode of activity, but rather point the way for further development of the theory. In the discussion that follows, the meetings that provided the basis for this study are described in more detail.

Case Study

The group that I observed for the case study was the group of individuals actually working on the proposed collaboration project. As indicated above, my observations of this group were exploratory. Thus, I observed the group for a fixed period of time, during May and June, 1990, as opposed to following the project from start to finish. Because it was summer-time, there was irregular attendance at meetings, making identification of group membership difficult. During these months the group was also awaiting word on funding for the project. Thus, these five meetings were tentative and preliminary.

Some group members had engaged in an earlier project that would

provide the basis for the proposed collaboration system. The goal of this earlier project was to develop a hypermedia system to support software development. They had recently produced an early prototype to illustrate several important concepts in the project. To solicit funding for the project, several of these same individuals had described the basis of the collaboration project in a proposal submitted to the National Science Foundation (NSF) [Smith et. al., 1990].

Other members of the group had not been involved in this prior work. Thus, at the time I began my observations of the group, much of the discussion concerned this earlier work. The prototype system was not formally part of the proposed collaboration system, but its work was expected to impact the project and thus was included in the group's discussions. Although the intent of the project had been described in the NSF proposal document, much of the group's discussions also involved developing concrete goals for the new project. The group was concerned with early considerations for implementing a second system to realize these goals. Thus, the group's overall intent for the summer was to hold discussions to begin examining ideas expressed in the NSF proposal, with the aim of their eventual implementation.

I describe five of the group's meetings below. I have changed the names of the group members to protect their identities. In presenting a synopsis of each meeting, I have included my own observations and then looked for situations where the proposed modes of activity framework could be applied. The meeting events are described in italics, while my own observations are in a Roman font. At the end of each meeting, I present a diagram showing the sequence of modes of activity engaged by the group during the meeting.

Meeting #1

The first meeting of the group was held in 325 Sitterson Hall on the UNC campus on 5-15-90. At this time the basis of the collaboration system project had been described in the NSF proposal document. Although some members of the group had previously collaborated to write the document, this was the first time (beyond the proposal writing stage) that both "old" and "new" group members had met together to begin discussing the new project.

The group had two leaders: Sam, a computer science faculty member, was the Principal Investigator of the project; and George, also a computer science faculty member, was the Project Co-Director. The other participants in this first meeting were faculty members Paul, David, and Bill and graduate students Tim and Fred. The purpose of this meeting was to conduct exploratory discussions on how to best build the collaboration system.

Sam opened by asking, "does everyone have a copy of the NSF proposal?" As the meeting began, Sam described some basics about how he thought the collaboration system should be built and explained different ideas he had for communication in the system. He noted that the group's task during the summer should be to "build the middle" of the collaboration system since he felt they already "[had] the bookends." George assumed a co-leader role by interjecting points as Sam explained his vision of the collaboration system.

Early in the meeting it was evident that the co-leaders had put previous thought into the system, while the other group members were still trying to understand the goals and vision of the project. Although the NSF proposal provided a preliminary view of the system the group members were unfamiliar with the leaders'

views. The group members asked questions to better understand the information presented.

The leaders continued to present their ideas on the proposed project. George described the new system as supporting collaborators using an application such as X-windows. Sam presented a general vision of the project by sketching a framework of the system on the whiteboard. In the drawing he included his ideas for candidate software tools in the system. There was some brief discussion of the figure, but no new ideas were generated by the group.

Thus, the leaders were aiming to provide the group with a vision of the project. The specific nature of George's X-windows example seemed to be especially helpful for relaying this vision since the group of computer scientists in the meeting were familiar with X-windows and, thus, could gain a clearer picture of what the co-leaders had in mind.

Up until this point in the meeting, the goals of the leaders seemed to be to present the project to the group members in order to inform them but also to solicit their involvement. Thus, the leaders were "teaching", or "presenting", while the other group members were learning. But, the members who were learning could accept or reject the information put before them. Thus, a constraint that the presentation be appealing was adapted by the leaders. The meeting was also constrained by the format of a presentation and by its level of generality, set by the leaders.

I classified this first segment of the meeting as an instance of presentation mode. Its specific features were as follows:

Mode type: Presentation

- Goals:**
- 1) to introduce the group to an existing body of information;
 - 2) to persuade individuals in the group to join the project;
- Product:** a group-level understanding of the basis of the project;
- Processes:**
- 1) Leaders: talking, teaching, presenting;
 - 2) Others: listening, learning, interpreting, evaluating;
- Constraints:**
- 1) information presented in an appealing manner;
 - 2) leaders controlled the floor; This doesn't imply that the leaders actually specified who was to speak next. Rather, they informally directed the flow of the conversation and the meeting.
 - 3) presentation was general;
 - 4) discussion was limited to brief questions and replies;

An hour into the meeting, the discussion turned from design of a potential system to the goal of the project. Fred questioned the purpose of the system. He pointed out that he was hearing two goals for the project. One goal was to help people collaborate over long distances, i.e. the goal of virtual proximity. The other goal was to help collaborators work with each other more efficiently and effectively, i.e. the goal of augmenting collaboration. Sam did not agree that the two goals were separate. Some discussion between group members followed, but Sam still believed that the two goals were coincident. Fred became frustrated and the issue was dropped at his request to "talk about something else."

Thus, the meeting had drifted from a presentation activity to one of discussion. This difference in activities can be seen in the more

dynamic interaction between group members during the discussion. Instead of individuals either listening or presenting, each was learning from the others through a balanced exchange of ideas. Since most of the members were engaged in this discussion, the majority of the individuals were in the same mode as the group itself - discussion mode. This discussion had the following characteristics:

Mode type: Conflict-Resolution

Goal: to resolve an issue; Thus, I call this type of discussion mode a conflict-resolution discussion mode. In this case, the issue to be solved was the goal of the collaboration project.

Product: a group-level awareness that there may be conflicting project goals; (Since no resolution was achieved, this awareness of potentially conflicting goals was the defacto product rather than the product most likely desired by the group.)

Process: dialog;

Constraints: 1) a particular topic was addressed;
2) different points of views were encouraged;

Next, George ended the meeting with several closing statements. He commented that he was interested in "who is going to be on the bandwagon." He then reiterated his proposed goal for the summer - to pursue the project until it can be articulated in a document - before the meeting adjourned.

Thus, the meeting ended with a summary characterized by the following:

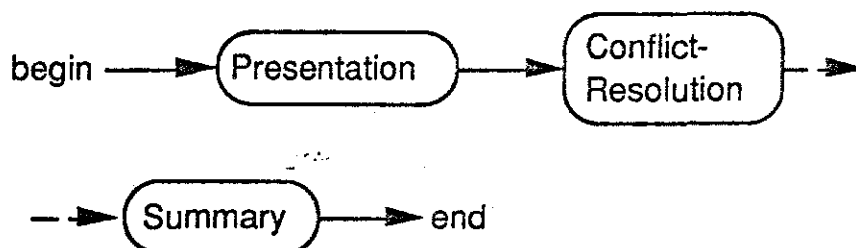
Mode type: Summary

- Goals:** 1) to bring the meeting to a close;
2) to re-emphasize an intermediate project goal;
- Product:** a stronger group-level sense of an intermediate project goal;
- Process:** 1) George: summarizing, recalling, evaluating, talking;
2) Others: recalling, listening;
- Constraint:** presentation/statement made by the group leader;

Overall, this first meeting was a presentation. The co-leaders were not soliciting information from the other group members, but were briefing them on the basics and the status of the project. This is seen in the fact that as Sam put the diagram on the white board, the other group members added nothing to it. Also, Fred's view that there seemed to be two separate goals for the project was ultimately dismissed. In addition, George's interest in "who is going to be on the bandwagon" presented the flavor of selling the other group members on an idea, and convincing them to join.

At the conclusion of this first meeting it seemed that each member of the group had a specific reason for working on the project. The group members' interests seemed to fall into one of two categories, the cognitive theory of the system or the technical design of the system. This split in interests of the group was reflected in the group leaders. Sam seemed primarily interested in the former category, while George seemed more interested in the latter.

Meeting #1 Mode Sequence



Meeting #2

The second meeting of this group took place one week later on 5-23-90. The only co-leader present was George (Sam was out of town). Bill and Paul were the only other faculty members present. Graduate students Fred and Tim also attended. The purpose of this meeting was to begin determining the software tools needed to build the collaboration system.

George opened by asking, "Who's here?" George immediately assumed the leadership role, but did ask if "anyone [had] an agenda for the day." When no one came up with an agenda, he announced that he would like to discuss the tools and applications needed to build the collaboration system.

George's opening comment reflected his concern in the first meeting about who would be joining the team. George's asking the group for an agenda served to give the other members a feeling that they shared control of the project. Perhaps this would further attract the individuals attending the meeting.

Fred was the first to offer a software tool needed in the new system. George went to the white board and began recording the

information offered by the other group members. After several tools were listed on the board, George began checking off and circling items as an indication of those he thought important.

Thus, the group began the second meeting in a brainstorming activity. This activity was initiated by the leader as he solicited ideas from the group. Because the project was in its infancy and little was firm, the group seemed to be in an exploratory mode. Thus, the constraints on the discussion were few, resulting in a free-form flow of conversation among group members. Although George was soliciting ideas from the others, he was still in control of how these ideas were presented on the board. George was thus in a slightly different cognitive mode than the other group members. He was interpreting while the individuals presenting candidate tools were brainstorming. The group as a whole was in a type of discussion mode, with the following characteristics:

Mode type: Brainstorming

Goal: to identify candidate tools needed in the collaboration system;

Product: a list of tools on the whiteboard;

Processes: 1) Overall: active, balanced exchange of ideas; Although not everyone participated, no one person did a majority of the talking.

2) George: interpreting, writing;

3) Others: brainstorming, offering items;

Constraints: 1) general topic identified;

2) low censorship with respect to relevance;

George then reiterated that the group was "deciding what tools are needed to complete a project." Tim asked him to define "project." The leader answered, "Good point. What kinds of projects should we aim for?"

Thus, the group was still not sure about the purpose of the collaboration system and was engaged in an ongoing process to define the system and its goals. In addition to the goals of each mode of activity that the group went through, the group seemed to share a general goal of developing a common understanding of the project.

About 15 minutes into the meeting, Paul stated that it is important "not to confuse the possible multiple roles of the computer." He explained that "building things for the computer and using the computer to build are two different things, and we shouldn't confuse the two." George gave a short argument to Paul's statement. Paul's response to George was "possibly." George then drew a diagram on the board, showing where he thought the project should be on a scale between "design" and "CASE tools."

Thus, through the diagram on the board, Paul and George had an understanding of the other's concept, although they may not have agreed on the subject. This example shows how differences in opinion can be acknowledged and understood. In a conflict-resolution mode, the individuals with the differing opinions debate until a common ground is located, or until positions are understood or left unresolved by agreement. This particular scenario had the following characteristics:

Mode type: Conflict-Resolution

Goal: to further specify the purpose of the project;

Product: a group-level awareness of the issue;

Process: dialog, debate;

Constraints: 1) a limited subset of the group participated in dialog;

- 2) a particular topic was addressed;
- 3) different points of view were encouraged;

As the meeting continued, Fred again brought up the issue that he had introduced in the first meeting: the goal of virtual proximity versus the goal of collaboration augmentation. He stated that a system with the goal of collaboration augmentation would require more prerequisite cognitive work, something that he indicated the "other group members [were] more interested in." He also described that a software system used to achieve virtual proximity would be more easily accepted by users.

Fred's comments again show that the group was divided in its interests. Fred was on the "virtual proximity" side of the house and was pushing the project in that direction. Thus, coalitions of individuals within the group were emerging. There seemed to be two groups, each defined by a separate goal for the collaboration project. Fred and George were in one group, while Sam was separated from them by his different goal for the project.

The meeting continued with more discussion of tools needed in the collaboration system. Fred explained that with the new system, users should be able to share documents although they may use different text editors. He pointed out a benefit of this as he said, "today people get together and bite the bullet and agree to use Tex even though they hate it."

About 45 minutes into the meeting, George presented a general summary of the meeting. He stated, "this discussion has been useful to me and has helped me understand the scope of what we are really talking about here." He also summarized a goal he had for the project.

George's summary seemed to be an attempt to bring the meeting to

a close. It also seemed to be an attempt to provide the other members of the group with the feeling that their time spent attending the meeting had been put to good use. Thus, the meeting had turned from a discussion to a summary with the following characteristics:

Mode type: Summary

Goals: 1) to bring the meeting to a close;
2) to assure group members of time spent profitably;

Product: a general description of the meeting;

Processes: 1) George: summarizing, recalling, evaluating, talking;
2) Others: recalling, listening;

Constraint: presentation/statement made by the group leader;

The meeting did not end, but went immediately back to discussion mode when Paul asked another question. Discussion of the function of the tools in the collaboration system followed. George described that he would like a way of "digging things out of files" when he needed them. Paul responded with, "that's the classic retrieval problem." No further discussion was given to this topic.

Because this group had a shared background of computer science, the three words "classic retrieval problem" conveyed a large range of ideas and George did not need to further describe his point. This brief discussion can be characterized by the following:

Mode type: Discussion

Goal: to discuss functionality of tools;

Product: a further group-level understanding of the project;

Process: dialog, exchange of ideas;

Constraint: a particular topic was addressed;

A few minutes later, George presented another summary and closing of the meeting. He concluded that the group had "done a good job of bringing things to the floor" and that he needed "some reflection" from the group members about issues discussed in the meeting.

Again, the summary was assurance of a profitable meeting and had the following characteristics:

Mode type: Summary

Goals: 1) to bring the meeting to a close;
2) to assure group members of time spent profitably;

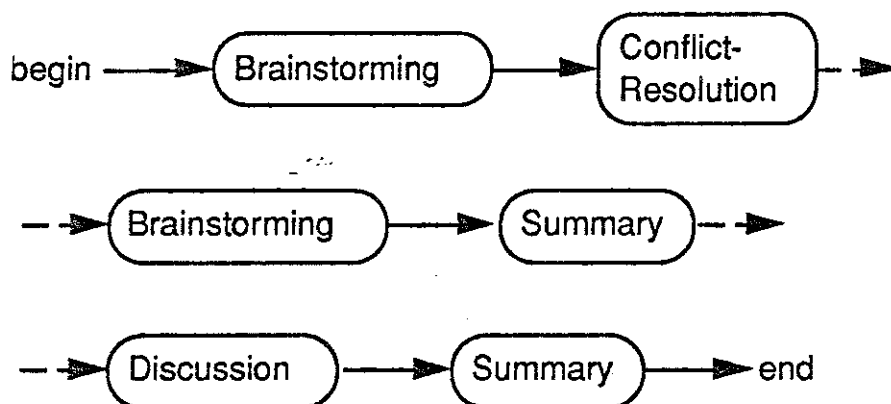
Product: a feeling of progress;

Processes: 1) George: summarizing, recalling, evaluating, talking;
2) Others: recalling, listening;

Constraint: presentation/statement made by the group leader;

This meeting, unlike the first, was full of discussion among members of the group. Instead of the group leader(s) holding the floor for long periods of time, as in the first meeting, this second meeting contained a balanced exchange of ideas among group members. The first meeting, in which groundwork was laid, prepared individuals to contribute in the second meeting, in which I classify the activities as predominantly brainstorming and discussion.

Meeting #2 Mode Sequence



Meeting #3

The third meeting of this group was held one week later on 5-30-90. Again, George was the only leader present. David and Bill were the faculty members at this meeting. The graduate students attending were Fred and Tim, who had attended earlier meetings, and Bob who attended for the first time. The purpose of this meeting was to present a proposal for the collaboration system and to prompt more discussion of related issues.

As the meeting opened, George observed that "the cast of characters [was] changing."

George's comment reflected his concern during the first meeting about who was going to be on the "bandwagon".

The previous day, George had presented an overview of the collaboration system to a departmental group in an attempt to solicit a small sum of departmentally-controlled funds to permit the group to purchase video equipment. The overview he presented

had been organized into a document called "Building and Using a Collaborator: A Foundation for Supporting and Studying Group Collaborations." He opened this third meeting with a report that his campaign had been successful.

George then displayed slides of the "Building and Using a Collaborator" document on the overhead projector and stated, "The reason I am [going over this document] is that it seems to me that we all have our own mental images of what this system should be." He continued with, "this proposal is mine - there may be others."

These overheads provided the group with another foundation on which to base their understanding of the project. At the same time, this was another chance for the leader to present his own vision of the project. Thus, this third meeting opened and promptly the group engaged in a presentation activity. This activity was instigated by the mediating device: the "Building and Using a Collaborator" document and had the following characteristics:

Mode type: Presentation

Goals: 1) to present the information in the "Building and Using a Collaborator" document;

2) to present his (George's) vision of the project;

Product: a group-level understanding of the information in the document;

Processes: 1) George: talking, presenting, teaching;

2) Others: listening, evaluating, learning;

Constraints: 1) presentation made by the group leader;

2) limited to topics in the "Building and Using a Collaborator" document;

During George's presentation, the group drifted back and forth

between presentation mode and discussion mode. As George presented a page of information on the overhead projector, questions from the group prompted a switch to discussion mode. The group remained in discussion mode until George presented a new page of information. Thus, the document provided an orderly way of discussing the project's basic issues.

Thirty minutes into the meeting, George pointed to the overhead and explained, "That's what we've been saying about this in public. I'd like to put this picture up and discuss it. If we're out talking about this to a group who is deciding about whether to work with us or not, we need to decide what to present to them."

George's concern suggests that the group had a need for separating information into that private to the group and that which would be public. Most importantly, the group members needed to agree on the information open to the public. Thus, there was much value in the goal of reaching a group-level understanding of the information presented.

More discussion followed. In trying to better define the goals of the project, George wondered out loud, "I'm trying to think of how and why people would use this system." After George gave his own examples of potential users of the system, no further discussion was offered by the group.

George's question, like others that helped define the goals of the project, had not been answered by the group. Perhaps it would be beneficial if the group were forced to remain on this subject for some time before dismissing it.

About 15 minutes later, George repeated his former question about who would use the collaboration system and why, and tried

to give a more specific example. He pointed out that we need a routine way of dealing with information. He stated that he would like to see his own mail organized for example. This time a discussion followed.

Because George made his question specific, the group was better able to respond in a focused and helpful manner. Thus, in his second attempt, the question received the group's attention.

George moved on to the design of the collaboration system. He asked the group how and to what extent they were going to accommodate editor preferences in the system. His question spurred a discussion of how to integrate different editors in the collaboration system. Next, the discussion turned to the technical aspects of converting data to be used by different editors. George then went to the whiteboard and drew a diagram of the information brought out in the discussion.

Throughout the remainder of the meeting, the group members applied the points they made to George's example of an editor. In addition, George's diagram on the whiteboard was used as a reference in the discussion thereafter. Thus, the successive alternation between presentation and discussion based on successive development of a single example may indicate a larger tactical configuration of modes that could prove quite interesting.

The discussion mode that had emerged in this portion of the meeting is characterized by the following:

Mode type: Discussion

Goal: to further explore issues presented in the document;

Product: diagrams on the whiteboard;

Process: building on examples, discussing, dialog;

Constraints: 1) different points of view were encouraged;

2) a particular topic was addressed;

After an hour and forty minutes, George presented a closing. He stated that he was "comfortable with the way the discussion [had] gone in the past hour." He summarized that the group was trying to provide linking and structuring tools that do not exist today. He then ended the meeting by pointing out that the group had met for a "long time" and that it had been a "very fruitful discussion."

This closing was similar to the closing of the previous meeting where his statements assured the group members of a successful meeting. This summary mode is characterized by the following:

Mode type: Summary

Goals:

- 1) to assure that group members received the same general information from the meeting;
- 2) to assure group members of time spent profitably;
- 3) to bring the meeting to a close;

Products:

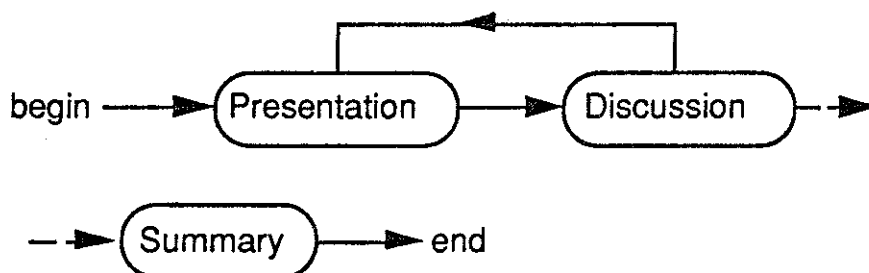
- 1) a group-level understanding of the information presented in the meeting;
- 2) a feeling of progress;

Processes:

- 1) George: talking, recalling, summarizing;
- 2) Others: listening, recalling;

Constraint: presentation/statement made by the group leader;

Meeting #3 Mode Sequence



Meeting #4

The fourth group meeting was held two weeks later on 6-13-90. The faculty members present were George, Sam, David, and Bill. The graduate students present were Fred and Mike. Mike had not been present at any of the other group meetings. The purpose of this meeting was to conduct more technical discussion and to continue defining the new collaboration system.

Fred opened the meeting by asking, "Do we have an agenda for today?" George answered that thing on the agenda was to "pick up the pieces since Sam [had] been out of town." George then summarized for the other co-leader the events that had occurred in the past two meetings.

Thus, the opening of the meeting was a summary with the following characteristics:

Mode type: Summary

Goal: to brief the group members (particularly Sam) on the status of the project;

Product: a group-level understanding of the progress made on the project;

Processes: 1) George: talking, recalling, summarizing;
2) Others: listening, recalling, evaluating;

Constraint: presentation/statement made by the group leader;

Discussion was then prompted by Bill, who brought up the issue of sequential versus parallel sending of messages from a server to clients. This question spurred a discussion on networking issues, in which most group members participated. At one point, the

group had two conversations going, one involving dialog between George and Fred and the other involving dialog between Sam and David. After a few minutes, the discussion turned back to one group conversation.

Through these two separate conversations, we see two subgroups of group members form briefly and then break up. The individuals who were in conversations with each other had matching, or at least similar, interests and goals for the project.

The group was brainstorming and discussing the ideas they came up with. This discussion activity had the following characteristics:

Mode type: Brainstorming

Goals: 1) to externalize technical ideas;
2) to discuss merit of ideas;

Product: a group-level understanding of ideas discussed;

Process: generating new ideas, dialog;

Constraint: different points of view were encouraged;

As the discussion continued, a disagreement emerged between Sam and George. George began to resolve the difference of opinions by stating, "maybe we're not assuming the same model - I'm thinking of" It turns out that Sam was thinking of a slightly different model. Thus the two were able to discuss the differences in the models they were thinking of, come to a common understanding, and continue on.

This is an example of the conflict-resolution type of discussion mode.

Mode type: Conflict-Resolution

Goal: to resolve the conflict;

- Product:** a group-level understanding of the issue;
- Processes:** 1) George and Sam: dialog;
2) Others: listening, evaluating;
- Constraints:** 1) conversation exclusively between George and Sam;
2) a particular topic was addressed;

Discussion followed on how to link tools without re-building the software application. George stated, "We want to preserve the functions of the application with some kind of wrap-around for the boxes, circle, etc. to form a link with the outside." About ten minutes later, George talked about "data-wrappers." Later, Fred described one of his ideas, saying, "if you allow the wrapper to be very application specific ..." Sam then gave an example of a simple case that he came up with. In his description, he also used the term wrapper. The discussion continued, with the word wrapper used to refer to the construct that the group envisioned enveloping the application.

Thus, the word "wrapper" evolved into a new term without explicitly being defined. During the time that the term was evolving, the group was in a brainstorming activity, with the following characteristics:

- Mode type:** Brainstorming
- Goal:** to develop ideas for a system infrastructure;
- Products:** 1) a group-level understanding of ideas discussed;
2) the term "wrapper";
- Process:** generating new ideas, dialog;
- Constraints:** 1) different points of view were encouraged;
2) a particular topic was addressed;

Sam soon changed the direction of the discussion by presenting

three unanswered questions about the collaboration system.

One of Sam's questions was whether the goal of the system was to create virtual proximity or to augment collaboration. It is interesting that in the first meeting when Fred brought this issue up, he seemed to be the only group member who saw this as a conflict. Now, Sam described it as one of the three pertinent questions facing the group. By presenting these three questions, Sam brought the group into a summary mode, where he gave a presentation of the issues he thought were important.

Mode type: Summary

Goals: 1) to summarize important project issues;
2) to present his (Sam's) views to the group;

Product: a group-level awareness of pertinent issues;

Processes: 1) Sam: summarizing, recalling, organizing;
2) Others: listening, recalling, interpreting, evaluating;

Constraint: presentation/statement made by the group leader;

As Sam continued his summary, he stated the "interesting aspects of the problem." He described that the cognitive issues of building the collaboration system should come first. George responded with, "it almost sounds like you would be happy if we could go out and purchase a system to study people." Discussion followed as the other group members joined in. Eventually, Sam attempted to resolve the conflict by stating that he had "abstract intellectual interests that in some ways could be disengaged from the project."

Thus, we see a conflict between the two project leaders over where the project's interesting problems lie. What followed was a conflict-resolution mode with the following characteristics:

Mode type: Conflict-Resolution

Goal: to further determine the goal(s) of the project;

Product: further group-level awareness of conflicting project goals;

Process: debate, dialog;

Constraints: 1) be persuasive; This would be necessary to gain support for one particular goal over another.
2) a particular topic was addressed;

During conflict-resolution activities in previous meetings, the individuals who participated in the conversation were those with the conflict. But in this case, other group members contributed to the dialog. This was probably because the conflict represented the differing goals of the system. As pointed out earlier, one group of individuals was particularly interested in the theoretical cognitive issues associated with building the collaborative system. The other group members were more interested in the system design problems associated with the project. Thus, the two goals emerged, creating the question: is the computer system for augmenting collaboration or for creating virtual proximity? This issue of the project's goal seemed particularly important to each group member.

Next, George went to the whiteboard to draw an architecture of the system. He solicited ideas by asking the group to tell him "where it [was] all wet." Sam went to the board with a reaction. He drew a slightly different architecture under George's figure. The group then discussed system design.

The group was again in discussion mode, with the following characteristics:

Mode type: Discussion

- Goal:** to externalize and evaluate ideas for the system architecture;
- Product:** two diagrams of possible system architectures;
- Process:** evaluating, dialog, writing on whiteboard, building and linking concepts;
- Constraints:** 1) Leaders were at whiteboard; Thus, the leaders had control over how ideas were to be represented in the diagram.
- 2) a particular topic was addressed;
- 3) different points of view were encouraged;

George and Fred continued talking, while Sam and Mike struck up an additional conversation.

This was the second time during the meeting that two conversations were taking place at the same time. In both cases each leader was involved with a separate conversation. Perhaps the two groups felt justified in talking at the same time because there was a leader participating in both. Again, coalitions were emerging.

The first work assignment was then given. Sam directed Fred to write a "wrapper" for a simple tool.

This assignment prompted the group to move into a delegation mode with the following characteristics:

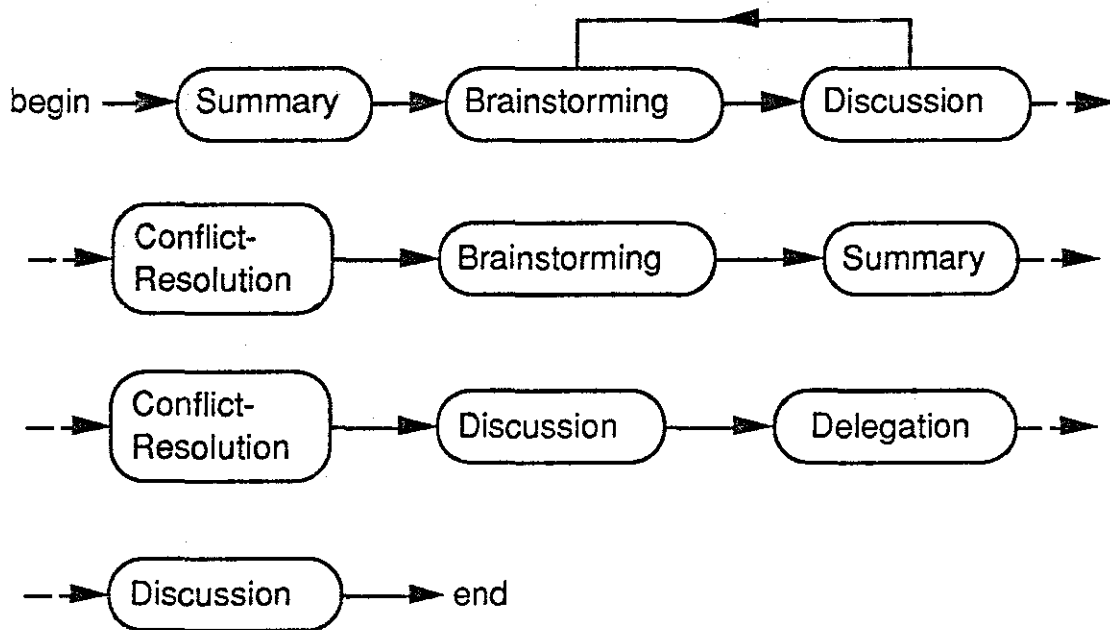
- Mode type:** Delegation
- Goal:** to assign a task;
- Product:** understanding of work responsibility;
- Processes:** 1) Sam: delegating, explaining;
2) Fred: listening, evaluating;
- Constraint:** Senior member delegating work to member with

less

seniority;

Bill then abruptly changed the conversation by asking if equipment had been ordered. This question lead the group into a short discussion before the meeting ended. Although Fred had asked several times for a close to the meeting, there was no summary or verbal closing.

Meeting #4 Mode Sequence



Meeting #5

The fifth meeting of this group was held the following week on 6-20-90. This meeting took place in the computer lab instead of the usual conference room. The purpose of this meeting was to demonstrate an early prototype system that had been developed by several members of the group. Sam was the only leader present at this meeting. David and Bill were the two faculty members who attended. Other participants were graduate students Fred, Bob, and

Mike who had been in earlier meetings, and newcomers Jeff and Mary. All were seated in a large ring around the workstation where the demo was shown.

Sam opened the meeting by explaining the concept behind the demo and then gave the floor to Bob. Bob then generated a diagram on the computer screen. David immediately asked questions. On his first question, Bob turned to Sam to ask if "he was going to field [the question]." Bob explained to Sam, "you took a breath like you were firing up." Bob continued by answering David's questions, but Sam soon added to his description. A short discussion between Sam and David on some points in the system followed.

Sam then suggested that Bob show some additional diagrams that the system was capable of generating. Sam then explained the diagrams shown on the screen. The conversation between David and Sam continued. A few other members of the group asked questions, but the majority of the conversation consisted of discussion and questions and answers between Sam and David.

Sam again instructed Bob to show another feature of the system and Bob proceeded with the demo. David asked a question which prompted another five-minute discussion with Sam. At a lull in the conversation, Bob continued the demo. Bob began answering some of David's questions, but David continued to address his questions to Sam.

David continued to ask questions for fifty minutes into the meeting before any other group members again participated in the conversation. At that point, Bob chose to bring up flow diagrams on the system and Fred began asking questions that were answered by Bob. But soon after, discussion continued almost exclusively between Sam and David until the end of the one-and-a-half hour meeting.

During this meeting it was obvious that Sam was impressed by the prototype system. This is seen in his comment, "we think there is a lot of power in this" and the fact that he had assembled a large group of people to view the demo. This is reminiscent of the presentation of the first meeting of the group, where the leaders were presenting information with hopes of soliciting support. During this fifth meeting, Sam seemed to be soliciting support for using concepts found in the prototype system to build the collaboration system.

Thus, the group was primarily in presentation mode. More explicitly, the group was in a type of presentation mode that I will call demo mode. This activity had the following characteristics:

Mode type: Demo

- Goals:**
 - 1) to present the system to the group;
 - 2) to solicit support for the system;
- Product:** a group-level understanding of the system;
- Processes:**
 - 1) Sam and Bob: presenting, explaining, demonstrating;
 - 2) Others: listening, evaluating;
- Constraints:**
 - 1) Demonstrator controlled flow of the meeting;
 - 2) demo presented in an appealing manner;
 - 3) activities and discussion determined by the demo;

But the group alternated between the demo and discussion modes of activity. Questions about the material presented in the demonstration caused the group to move from demo mode to discussion mode. The leaders of the demonstration, Sam and Bob, caused a modal switch back into demo mode by continuing with the demonstration and explaining new features. The discussions

prompted by David's questions were characterized by the following:

Mode type: Discussion

Goal: to understand the system;

Product: a group-level understanding of the system;

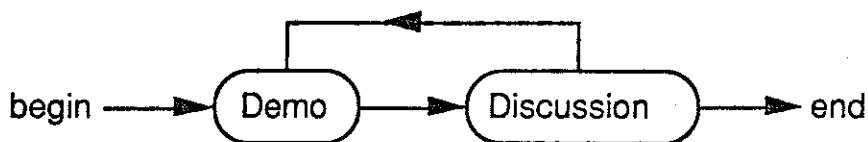
Processes: 1) Sam and Bob: dialog, explaining;
2) Others: dialog, evaluating, questioning;

Constraint: a particular topic was addressed;

Throughout this meeting, Sam assumed a leadership position, although Bob was actually in charge of the demo. This is seen in the fact that Sam followed up Bob's answers to questions with additional information. Thus, questions were often directed implicitly to Sam through eye contact. In addition, Sam often suggested to Bob the direction in which the demo should go.

The discussions in this meeting were held by a few members of the group, while the rest of the group watched and listened. I think that a couple of factors contributed to this situation. First, there were several individuals who had not been present at previous meetings of the group, and thus were new to the group. In addition, the collaborative project was not the subject of this meeting. This meeting was a presentation to gain acceptance for the prototype system instead of a discussion about the collaborative system.

Meeting #5 Mode Sequence



Conclusion

This project was a pilot study to determine the viability of characterizing a group's behavior by modes of activity. During the time I observed the group, little was generated by the group in the form of tangible products, although a number of 'intangible' products were "apparent." Because the group was in its infancy, much work for this 3-year project was left to be done on the collaboration project as my 2-month project came to a close. Thus, my case study was an observation of only a small portion of the group's continuing activities. In addition, my observations were limited to the planned, weekly meetings of the group. Further case studies could include observations of correspondence between group members or observations of subgroups of members as they work together on various tasks. In addition, later stages of a group's behavior should be observed and classified. For example, the modes of activities, strategies, and coalitions of a mature group may be much different than those of the new group that I observed.

Through my observations and classification of the activities of this group in their meetings, I have shown that focusing on the modes of activities of a group provides a useful method of classifying a group's behavior. This classification provides a framework for group observations, and an orderly method of describing and understanding the observed behavior. Thus, as this project comes to a close, it has achieved its purpose.

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