Applying social psychological theory to the problems of group work.

Robert E. Kraut
Carnegie Mellon University

Chapter prepared for
J. Carrol (Ed.). Theories in Human-Computer Interaction.

Version 3b, 8/31/2001

1. Motivation (1-2 pages)

The sub-field of Human Computer Interaction known as Computer Supported Cooperative Work (CSCW) attempts to build tools that help collections of individuals to accomplish their work, as well as their learning and play, more effectively. It also examines the how groups incorporate these tools into their routines and the impact that various technologies have on group processes and outcomes. The sub-field of CSCW grew out of dissatisfaction with the individualistic emphasis in early research in Human Computer Interaction, with its overwhelming concern with single individuals using computers to perform routine tasks. Much of this early research drew upon theories in cognitive psychology (e.g., Card, Moran and Newell, 1983). This individualistic emphasis contrasted with the everyday observation that much work activity is done by groups interdependent individuals collaborating (or competing) on ill-structured tasks.

In the work arena, groups are a major mechanism for organizations to tackle problems that are too large or complex for individuals to solve alone. For example, modern software packages, like Microsoft's Excel™, consist of over a million lines of computer code, while a good programmer typically writes a few thousand lines of code a year (Somerville, 2001; see Boehm et al, 1995, for more precise estimate of productivity in software engineering). To construct these massive applications, companies bring together different individuals with skill in such disparate topics as requirements analysis, interviewing, software architecture, algorithms, programming, graphics, user interfaces, evaluation, and the application domain. Every few people are polymaths, with skills in all these areas. Thus, both the scale and scope involved in building large software applications demand group effort of some sort.

The experimental literature shows that groups on average groups perform better than the individuals who comprise them. For example, they produce more and better ideas than a single individual when brainstorming or solve problems more accurately than the typical person in the group. (Gigone, & Hastie, 1997; Hill, 1982). The extent to which group performance exceeds that of a random member and the mechanisms through which this improvement is achieved depends upon the task. For example, a group's estimate of the life expectancy of different races and genders is likely to be more accurate

than the estimate of one its members selected at random. Similarly, it is more likely to solve puzzles of the sort illustrated in Figure x (hole in one) than a random member. On the life expectancy type problems, groups seem to follow a "truth supported wins" policy (McGrath, 1984). One or more members typically figure out the answer, and that answer is accepted if another member agrees with it. As a result, in these types of problems, the group estimate is likely to be better than a group member selected at random, but less accurate than the best estimate of the group (because sometimes the best estimate isn't supported). In contrast, the hole in one type problems are known as eureka problems, For these types of problems, once one member figures out the answer, its accuracy is self-evident. For eureka type problems, groups seem to use a "truth revealed wins" policy.

There are two basic mechanisms by which groups do better than individuals—aggregation and synergy. First and most simply, the different individuals who make up a group bring unique resources to it. They bring energy, and differences in knowledge, skills, and attitudes that are often essential for accomplishing some task. As we indicated in the case of software engineering, the large size of software projects and the range of knowledge and skills they require means that no single individual could construct a large software project individually. Second, and more difficult to explain, is synergy. Synergy is the increase in effectiveness that comes about through joint action or cooperation. It is the result of groups building upon the resources that its members contribute and going beyond them. It is, for example, the creative solution that occurs when members with different points of view or different backgrounds try to solve a problem and achieve a solution that goes beyond what any of the members know before they got together.

Consider the case of new product design. IDEO is one of the most successful new product design firms in the United States.. When trying to develop a new designs, such as, for example, a shopper-friendly, child-safe grocery cart which resists theft, it routinely mixes biologists, engineers, historians, and designers together on its design teams (ABC, 19xx). It creates a physical environment and work process to bring together ideas from different discipline in new and creative ways (Hargadon & Sutton, 1997). For example, it maintains archives of toys and gadgets, has an organizational structure that downplays status differences among managers and employees, evaluates employees based on

helpfulness to others as well as creativity, and emphases brainstorming meetings as a way to shape ideas.

2. Overview (2-3 pages)

Figure X.1 is a conceptual map of the CSCW area, showing the variety of research issues it addresses, differing in activity, topics, and scope. The modal CSCW research project focuses on small groups interacting with computer or communication applications. Some researchers in the CSCW area come from the more engineering oriented disciplines of computer science and electrical engineering, which put great value on the engineering and building of systems and applications. Their research emphases the attributes of applications and how to build them (e.g. Ackerman, 1992). Others come from the social science disciplines of psychology, sociology, anthropology, and

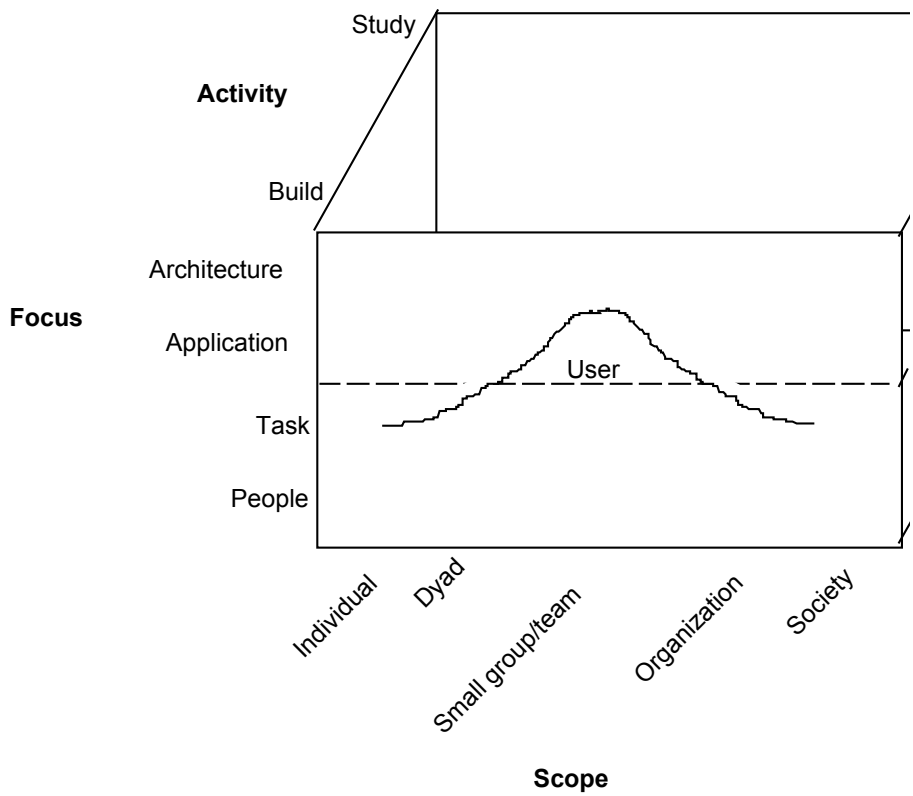


Figure X: Prototypicality of CSCW research, based on the approach taken.

communication studies. These disciplines typically value the empirical description of a social phenomenon and identifying the causal mechanisms that influence them. Their

CSCW research often describes how applications were used and the consequences their use has (Orlikowski, 2000)..

There is variation around the modal research. Consistent with the discipline-based activities of building and studying is the focus that researchers have. Research topics range from the software and telecommunications infrastructures and architectures, which are necessary to support CSCW applications (e.g., Dewan, 2000) to basic empirical research on the behavior of groups (Kraut, Galegher & Egido, 1988; Hughes, King, Rodden, and Andersen, 1994; . Suchman, 1987). These empirical studies often provide fundamental knowledge to engineer applications to support group work. CSCW research also varies in the size of the social collective it considers. The typical size or scope of the social collective treated in most CSCW research is small groups or teams of between three and a dozen people. However, the scope can range from dyads (Clark and Brennan, 1990; Monk, this volume) to organizations (Burton, this volume), to communities (Preece, 2000) and beyond.

We try to create technology to support groups for two primary reasons—to support distributed groups and to make traditional, collocated groups more effective. First, we want to get the benefit of groups in settings and for tasks where they had not previously been practical. As a result of consolidation, acquisition, and globalization, many work groups consist of individuals with offices in different locations. For example, engineering teams modern aircraft have designers in multiple locations around the United States and world. (Argyres,1999). One recent study of team in a multinational corporation showed that about 50% of them consisted of members located in different cities. (Cummings, 2001). Similarly, a large consulting and research company headquartered in Washington DC, found that X% of it projects in the year 2000 consisted of employees from at least different cities in the US. One goal of CSCW research has been to develop technology that would allow distributed teams work as if they were collocated.

A second goal of CSCW systems is to help both collocated and distributed teams perform better than they would otherwise. As already mentioned the reasons for creating

groups to do work is that they can accomplish tasks beyond the scope of individuals. On the other hand, combining individuals into groups often leads to poorer performance than one would expect if the combination were "frictionless". Steiner (1972) uses the term "processes loss" to describe this decline in performance from some theoretical maxim.

The contention of the current chapter is that both of these goals require deep knowledge of the factors that make groups effective or that undermine their effectiveness. This knowledge, for example, who help us to understand what makes distributed groups harder once they are formed (Cramton, In press; Olsen & Olsen, In press; Kraut, Fussell, Brennan & Siegel, In press). It will also suggest remedial actions to take to overcome known inefficiencies in groups, such as their tendency come to consensus before they have sufficiently explored issues or their tendency to have unequal participation of their members.

3. Scientific foundations (6-10 pages)

Since the turn of the 20th century (Ross, 1908) and especially since World War Two, the field of social psychology has developed a rich theoretical base to understand and predict group behavior. The goal of this chapter is to provide a brief introduction to the nature of groups and to give the reader a taste of social psychological theories about group behavior are and how they can contribute to the design of collaborative systems. I use the term "social psychological theories" advisedly. There is no unified theory in modern American social psychology, with pretensions of explaining all of social behavior. Rather the intellectual style has been to build and test a large number of medium level theories, each attempting to account for interesting social phenomenon in a limited domain. However, unlike theories in cognitive psychology, this theoretical base has been inadequately mined in the HCI and CSCW literatures.

This chapter will only scratch the surface of the literature on groups in social psychological and organizational behavior research. Our overview will start with McGrath's classic review of the small group laboratory literature up to the mid-1980's. Even though the empirical review is dated, McGrath provides an excellent framework for thinking about research on groups. More recent texts and handbooks in social

psychology provide citations to the current literature(Aronson, 1999; Baron, Byrne, 1999; Gilbert, Fiske, Lindzey, 1998; Hogg, & Tinsdale, 2001).

Input-Process-Output Models of Group Functioning.

There is substantial agreement among social psychologists about the classes of factors that influence group outcomes. Among the most useful frameworks for thinking about groups and their effectiveness are the input process output models summarized by Steiner (1972), Hackman (1983) and Mcgrath, 1984). Figure 2 illustrates the basic features of an input-process-output model.

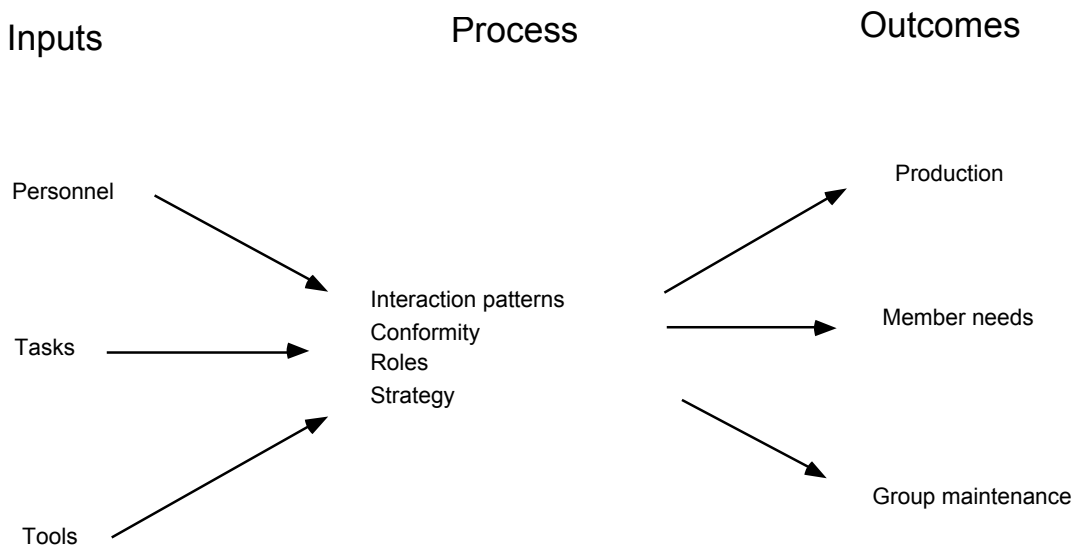


Figure X: Elements of an Input-Process-Output Model of Groups

Outcomes.

Types of outcomes. Input-process-output models emphasize that the outputs of a work group are multidimensional. Often when lay people think of workgroups they judges its success in terms of production—task outcomes that are acceptable to those who receive or review them, produced as efficiently and effectively as possible. For example, one might judge a software engineering team based upon the quality and quantity of the software it produce, a factory team based upon the number of cars it assembles, a team of

scientists based upon the theories or empirical observations they make, or a design team based upon the new product ideas they have. By the production criterion, groups are successful if they meet their production goals, and useful technologies are those that help them do so more efficiently or in new configurations. By these criteria, the success of groups is analogous to the success of individual work—more efficient or effective production.

There are at least two additional goals that distinguish group activity from individual activity. To be successful, groups also need to have the capability to work together in the future (group maintenance) and to support the needs of individuals within the group (member support) (Hackman, 1987). Consider a scientific team putting together a research proposal to a granting agency. Their proposal convinces the reviewers and the granting agency, and they receive $800,000 dollars. By a production criterion the group was successful, because it produced a high quality task output acceptable to the reviewers. The team also needs to maintain itself as a group to be successful. For example, if the process of writing the proposal was so stressful that the team was not willing to work together once they received their funding, that group was not successful by the group maintenance criterion. Similarly they would need to recruit graduate students, convince department heads to grant them space, and perform a host of other activities to maintain themselves as a group.

In addition to production and group maintenance, successful teams also support their members. For example, we would consider the scientific team more successful if members were happy, were able to meet personal career goals, or learned from each other in the process of working together.

Relationships among outcomes. These outcomes of groups do not change in lockstep. In many real world groups, for example, productivity and job satisfaction are only weakly correlated (Psych Bull, 2001;mean r ~ .30). Interventions designed to improve one of these outcomes may have a debilitating effect on another. For example, Levitt demonstrated that increasing structure in communication by having all messages flow through a coordinator can improve the efficiency with groups perform simple distributed problem-solving task. However, the same intervention also harms members' satisfaction with the group. Similarly, Connelly and xx have shown that having a skeptic

in a brainstorming group causes the group to generate more ideas of higher quality. Again, however, this intervention decreases members' satisfaction with the group.

According to Input-Process-Output models, both inputs to the group and the processes groups use when working together influence whether groups will be effective, that is achieve their production goals, meet members needs, and maintain themselves over time. The inputs have both a direct effect on group effectiveness and indirectly, by influencing the group process. Inputs include such resources as personnel, task, tools and time.

People.

Consider personnel. Obviously groups composed of more qualified people—having appropriate knowledge, skills, and motivation—will on average be more effective than groups with less qualified members. For example, new product development teams

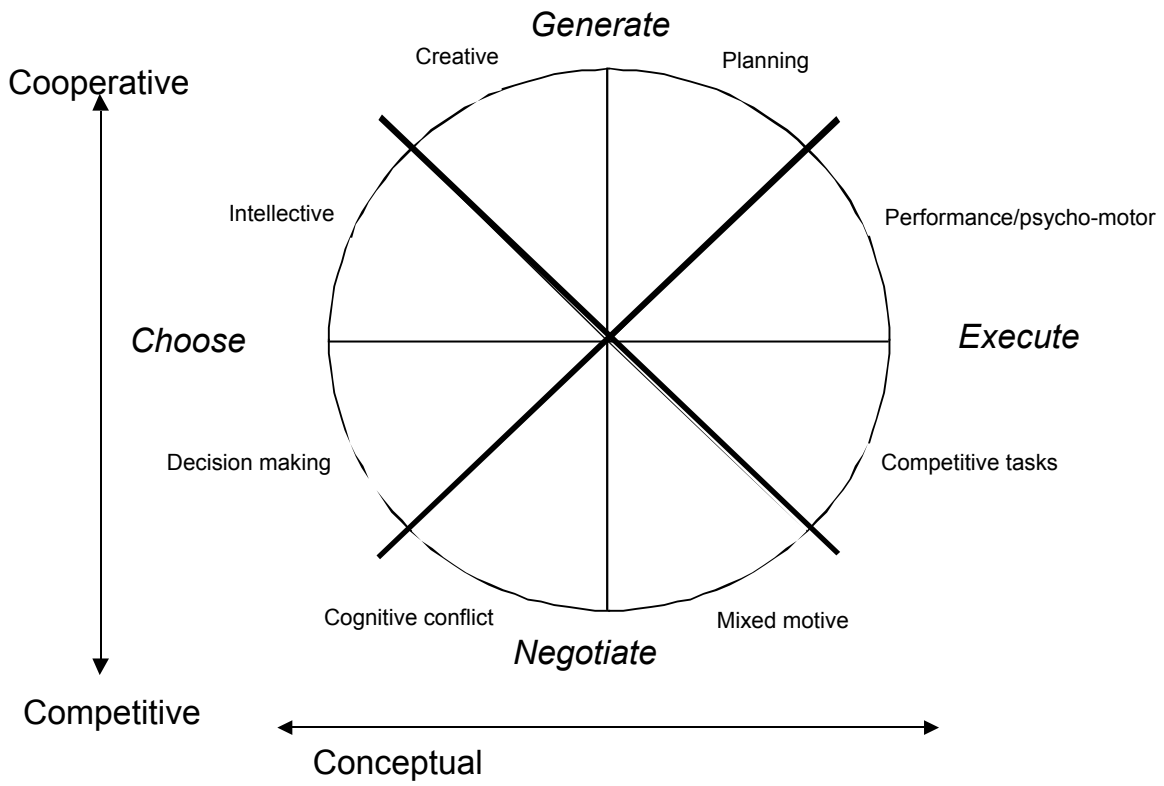


Figure X: Taxonomy of group task (from adapted from McGrath, 19xx)

with members having expertise in a wide variety of disciplines have the potential for

being highly creative, by bringing old ideas together in new ways (Ideo case, Sutton);. Work groups that are functionally diverse have a larger stock of ideas to draw upon, and differences in assumptions that allow them.

However, diversity can be a mixed blessing. Miliken and Martins's review (1996) demonstrates that functional diversity, demographic diversity, diversity ilenght of time with an organization can lead to crippling frustration and conflict within a group. It is difficult for individuals from divergent backgrounds to share a common enough language to communicate efficiently (Clark & Isaccson, 19xx). Language and value conflicts among designers, engineers, and marketing personnel on a new product team, for example, may cause them to talk past each other rather than being a source of synergy.

Task.

As discussed previously, on average groups do better than the individuals who comprise them on many tasks. But the extent to they exceed the capabilities of individuals and the processes by which they achieve this success depend upon characteristics of that task. McGrath (19xx) has developed an influential taxonomy of the tasks that comprise group work. (See Figure X). The taxomony was originally developed to describe the artifical tasks that characterize laboratory experiments on group behavior; in the real world, any group is likely to engage in most of these tasks, to varying degrees. Despite this limitation, the taxonomy is useful for highlighting how even small changes in task definition are likely to influence group effectiveness.

The upper lefthand quadrant of McGrath's circumplex consists of cooperative, cognitive tasks. Among these, McGrath distinguishes among generative tasks, such as brainstorming, where groups develop new ideas, from intellective tasks, in which groups answer math or other problems with correct answers, from more open ended problem solving tasks. A typical brainstorming task asks groups of subjects to identify new uses for a fork or to solve a campus parking problem. In brainstorming tasks, groups produce more good ideas than does a typical individual in them. The primary mechanism seems to be mere aggregation, in which multiple individuals, even if they are not interacting, are likely to generate more unique good ideas than any single one of them,. However,

synergy can also play a role, since in interacting groups one person's ideas may spark variations from others (Paulus, 19xx).

In one subset of intellective tasks, including anagrams and Eureka problems, the solution can be easily verified once generated. On these tasks, groups tend to be as good as the best person in them on any trial. These tasks follow a "truth wins" rule. Once one person solves the problem and communicates the answer the group, the group accepts it. Again, aggregation is the key, because a group is more likely to contain an individual who can figure out the correct answer than a random selection from the group. Finally, ambiguous problem solving tasks are those with multiple acceptable solutions or where the correct answer can not be easily verified, include world knowledge problems (e.g.., the morbidity rate for black males) or difficult math problems. In these tasks, groups tend to be as good as the second best person in them in any trial and seem to follow a "trust supported" heuristic. Interaction in the group allows the group to pool information and to fix errors, though a process of both aggregation and synergy.

Technologies.

The focus in much of the research in CSCW is on building technology that helps both conventional and distributed groups to be more effective. The social science tradition considers technology broadly to include both the ways in which groups are structured and the artifacts they use. Thus, for example, the assembly line in an auto plant is a technology, which consists of the division of labor, breaking down a the assembly task into a sequence of subtasks performed by different individuals and the conveyor belts, which move components from one station to another.

Just as groups should be more effective if they have more qualified personnel, it is obvious that they would also be more effective if they had appropriate technology to support their activities. The intellectual and managerial challenge is identifying what technologies are appropriate for what task.

One of the most important technologies that enables frequent and interactive communication is physical proximity. It is for this reason that work groups are often collocated in organizations. Groups are less likely to form or be formed among people

who are geographically separated. If distributed groups are formed, they have more difficulty in setting directing, in coordinating their work, and in forming successful working relationship than do teams whose members are collocated (Olsen & Olsen; Kraut et al, Cramton).

Interaction processes.

Contingency theory in organizational behavior holds no technology is appropriate for all groups, and holds that the technology needed to support a group varies greatly with the tasks that typically confront the group. Organization theorists emphasize uncertainty as one key feature of tasks, different technologies appropriate for them. (Lorce & Lawrence; Gailbraith).

Consider how the nature of the task might interact with the mechanisms that group could use to communicate. At one extreme are highly routinized tasks conducted in a stable environment, such as done by the staff in a fast food restaurant. In this environment, communication among workers assembling an order of burgers, fries and a shake can be highly ritualized. The counter-clerk can enter the order on the keypad of the cash register, which then updates a queue on a video screen behind the counter. By glancing at the list on screen, the fryer and griller know how much food to cook, and the assembler can grab fries and the burger from the staging area and pour a shake, without any direct communication with other team members. More extensive, direct communication among them is unnecessary and is likely to interfere with their ability to keep up with demand during peak meal times. In contrast, communication among research scientists collaborating on a project or members of a hospital emergency room must be more direct and interactive. Substantial research shows that frequent, direct, and interactive communication is more necessary as the uncertainty of the task increases. (Argote; Tushman; Pelz & Andrews). Uncertainty can increase because of interdependence among team members, tight time constraints, or greater variability, among other factors (Kraut & Streeter, 19xx).

The traditional view in group research is that inputs such as people, tasks, and technology have a dual impact on group effectiveness. They can influence outcomes

directly and they can influence the outcomes by changing the way that group members interact with each other. For example, groups may be better able to complete a well defined task, because it is easier for them to figure out evaluate solutions against clear criteria. This is an example of a direct effect of task on performance. In contrast, having a well-defined task may make it easier for groups to establish a clear division of labor, in which each member knows his or her responsibilities and how subtask will be integrated. In this sense, the task is influencing group effectiveness by changing the group interaction and reducing coordination costs.

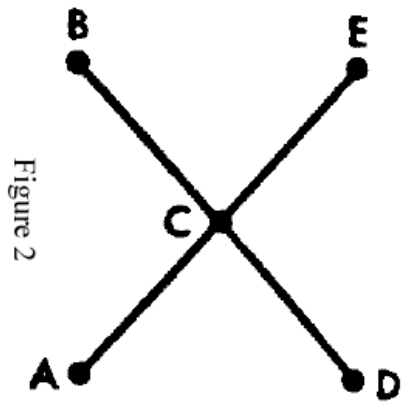


Figure 2

Figure Xa: Wheel structure

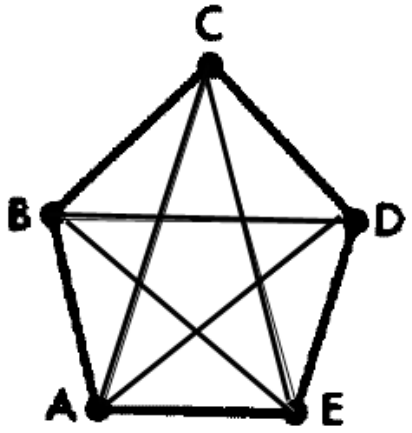


Figure 1

Figure Xb: Fully-connected structure

Communication is the basic component of group interaction. One can characterize group communication in terms of its volume, its structure, its content, and it interactive features. [[Examples.]] A basic finding from both laboratory experiments and field studies in organizations is that the right combination volume, structure, content and interactivity in group communication depends upon the task. For example, in classic experiments, Leavitt(19xx) demonstrated that in a simple distributed problem solving task, having all messages flow through a communication coordinator increased efficiency. In this task, groups of five were required to ??identify a unique card among a set that had previously been distributed to them. Here having a wheel communication structure (Figure Xa), in which all messages were given to person C who in turn passed them on to their destination, was more efficient than the fully connected graph in Figure Xb, where each group member could directly connect with every other one. However, in

a moderately complex task, in which the group needed to xxx, the fully connected graph was superior to the wheel (Shaw, 1964).

Field studies of teams in organizational settings show similar results. Tushman's (1979) research compared teams performing tasks differing in uncertainty in research and development organizations. Let us contrast teams doing service work (e.g., maintaining laboratory equipment), a relatively certain and simple task, with those doing basic research, a more uncertain and complex task. When service teams were organized more hierarchically, with a supervisor central to both communication and coordination, they were more successful than when they were organized in group with a less important supervisor and more peer-to-peer communication. In contrast, basic research teams were more successful when they engaged in more peer-to-peer communication and had a diminished role for the supervisor. Argote (19xx) found similar results among emergency room crews in hospitals, when uncertainty was operationalized by the diversity of injuries and illness that they dealt with. In emergency rooms with less diverse emergencies, crews were more effective when they were organized hierarchically and followed rule books; on the other hand, crews in the more uncertain emergency rooms were more effective when they coordinated their work through peer-to-peer communication.

Process losses

Even though on average groups do better than an average member, for many tasks groups do worse the theoretical maximum one would expect, given the resources members bring to the group. Steiner (1976) terms this the general problem of "process losses", in which the mere fact of being in a group degrades performance from what the members would be capable of producing. Consider the intellective tasks described previously. As previously described, the basic finding is that groups perform as well as their second best member, and that an individuals' answer on one of these tasks is accepted only if a second member supports it. This means that in many groups, a group member had a better answer than the one the group as a whole finally agreed upon.

Analogous phenomena occur in real world groups as well. One might expect, for example, that teams with greater diversity should outperform more homogeneous teams, because the diverse teams can bring a richer, non-redundant set of resource to bear on problems. IDEO, a highly regarded new product development company, attributes part of its success to a staff that brings engineers, designers, computer scientists, biologists, artists, historians and others together. The diversity of academic and work experiences allows helps the teams to bring together ideas from many disciplines when designing products (Hardegon & Sutton, 19xx; ABC nightline). Yet, despite these expectations, reviews of the research literature show that function and demographic diversity in work groups have mixed effects (review. 19xx). They only occasionally lead to production benefits and frequently lead to dissatisfaction with the group and turnover in group membership.

Processes losses come about through two distinct processes: coordination problems and motivation problems.

Coordination problems: Groups are inherently different from individuals performing the same task because of the need to coordinate. Whenever the work of individuals is interdependent, they must coordinate to achieve success (Van de Ven, Delbecq. & Koenig, 1976). This process of coordination takes effort, which could otherwise be directed towards direct production. Indeed, Malone and Crowston (1994), among others, define coordination as the extra activities people must do when working in

Coordination problem	**Definition**
Coordination effort	Time and effect invested in coordination deducts times and effect from production and group maintenance
Misaligned goals	Value differences or political differences among group members prevent them from pursuing common goals
Misaligned communication	Individuals have difficulty communicating with each other because of differences in assumption, vocabulary, location, and other impediments to achieving common ground.
Conformity pressures	Individuals are less likely to express personal beliefs and ideas because of social influences, such as imitation or evaluation apprehension
Synchronization problems	Output offered by one individual in a group do not meet the inputs need by another, because they are of the wrong form or arrive at the wrong time
Production blocking	Scare resources, such as time in a meeting or production tools, can't be simultaneously used, and some group members remain idle while others work.

Table X: Examples of coordination problems

concert to accomplish some goal, over and above what they would need to do to accomplish the goal individually. Coordination consists of broad alignment of goals, as when a management team sets a direction with implications for marketing and engineering. It also consists of detailed alignment of behavior, as when a coxswain shouts "stroke" to coordinate the behavior of a rowing crew. When coordination is high, a unit of individual work will translate into more team output. Conversely, when coordination is low, the same quality and quantity of individual work will result in less group output.

A wide variety of distinct mechanisms lead to process losses because of coordination problems. Table X provides a sampling of these mechanisms. Several of these mechanisms partially account for the failure of functional diversity in groups to lead to the expected gains in creativity and production. For example, people with different functional backgrounds often have different vocabularies, standard operating procedures, values and goals. Differences in these factors make it more difficult for groups to coordination. For example, experimental research shows that group productivity is hurt when people have incompatible, personal goals (Getting cones from a bottle.Mintz, 1951). When US F-15 jet fighter pilots shot down two US Army Black Hawk helicopters during the Iraq peace-keeping mission in 1994, among the reasons were that the Army and Air Force pilots had different vocabulary, standard operating procedures, and values. As a result, they had unique interpretations for the same military acronym, which caused them to interpret orders differently and differences in equipment which made communication between them difficult. The Army's value on flexibility and the Air Force's value on precision in planning led to different standard operating procedures, whereby the helicopters received their flight routes just moments before a flight, while the Air Force had detailed flight plans in place 24 hours before their flights. These problems were compounded by a number of others. The results where that on April 14, 1994, the helicopters US helicopters were in a no fly zone patrolled by the F-15s, and were shot down by them (Snook, 2000).

Motivational problems. In addition to the coordination costs of having to align, schedule and integrate individual efforts, working in a group also influences the motivations of the group members. Sometimes being in a group enhances individual motivation and other times it undercuts it. Groups, for example, establish norms about how hard members should work. "Rate-boosters" and "slackers" are terms for people who expend more or less effort, respectively, in relationship to an implicit group norm. Other group members often put pressure to conform on those who deviate from the group norm. Whether the group norm is to work hard or slack off often depends upon history, on explicit goals that are set for the group (Locke & Edwards, 19xx), and upon whether group members directly participated in the goal-setting or whether it was imposed upon them (Coch and French, 1964). For example, members generally conform more to the production goals if they had a hand in setting them.

[[Collins, p. 190]] Sometime merely being in the presence of another is sufficnet to change motivation. Social facilitation is one of the oldest phenomena identified in social psychology. Trippet's 1897 experiments on pacing and competition examined the consequences of the mere presence of others on upon an individual's behavior (Triplett, 1897). Zajonc (1965) reviewed evidence to show that merely being in the presence of another seems to increase individual arousal, across many species, including humans. A basic principle of behavioral theory is that increased arousal makes the most dominant response (i.e., the one most poised for being emitted) in a situation even more dominant. Findings that animal eat more in the presence of others and that people laugh more in when watching a comedy in the presence of others are consistent with this proposition. The implication of this proposition is that the presence of other people will facilitate performance when a task is well-learned, but will degrade performance with new tasks. For example, all else being equal, compared to working alone, people working in a group should have more difficulty learning a complex new task, but should perform better executing well learned tasks.

Social loafing is another phenomenon in which group membership degrades individual motivation. The basic empirical phenomenon is that individuals typically

work less hard when they are part of a group than when they are working on their own. The issue here isn't the mere presence of others. Rather social loafing occurs when people think that the outcome of their efforts are being pooled with the efforts of other group members. The phenomenon was first identified by Ringelmann (cited in Kravitz & Martin, 1986). When volunteers pulled on a rope connected to a strain gage, as the number of volunteers increased, the force they exerted declined from the amounted one would expect by summing the volunteer's efforts when working individually. Ingham, Levinger, Graves and Peckham (1974) demonstrated that the effect was the result of decreased effort and not failures of coordination by comparing blind-folded volunteers who believed that they were pulling alone to those who those who thought that they were jointly pulling on the rope. By the time of Karau and Williams review in 1993, researchers has demonstrated the phenomenon in over 80 experiments in both laboratory and field settings, using a wide variety of tasks, including physical ones (e.g., rope pulling, swimming) and cognitive ones (e.g., brain storming, evaluating poems, keeping vigilance).

Although social loafing is a robust phenomenon, the amount that being in a group leads to social loafing varies with the nature of the task and the nature of the group. In particular, an individual will engage in less social loafing if the individual is working in an attractive group, if the task is personally satisfying or engaging, if the individual things other members will perform poorly, if the individual thinks his or her own contribution is unique, if the individual's own output is visible to other group members, or if the individual is a women, someone raised in an Asian culture, or a child.

Karau and Williams (1994) developed an integrated theory of social loafing, which accounts well for prior research. This is illustrated in Figure X. The basic assumption is that people will work hard (greater motivational force) if they think their effort will lead to some performance that will help to achieve some valued goal. Thus changing the link between their effort and the outcome or changing the valence of the outcome should influence the effort they exert. This model predicts that when working in a group, , individuals would work harder when they think that their contributions are

unique or that other members will perform poorly, because in these cases their effort is more essential for group success, which is presumably a valued outcome. In addition individuals should work harder if they like the group, because this increases the value of the outcome for them. According to Karau and Williams (1994), women, Asians and children are less likely to socially loaf because these people have been socialized to have a more collectivist orientation (or in the case of children, have not yet been socialized towards a individualistic orientation). Therefore, these people are more likely to value the success of a group, compared to men, Westerns, and adults.

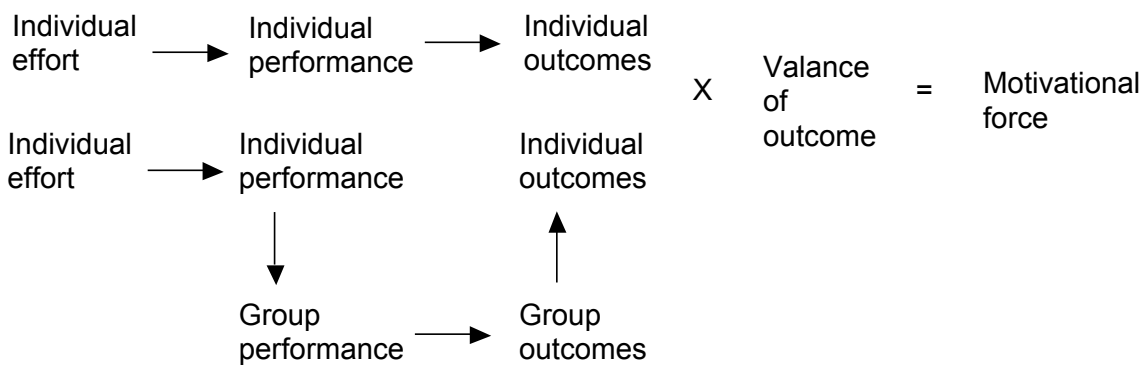


Figure X: A theory of social loafing (from Karau and Williams, 1994).

4. "Detailed" description (6-10 pages)

[Leverage the description of the science foundations in 3 to present a more detailed description of the approach. The key goal is to show how specific elements of the science foundation help to back up and guide the method/approach. The detailed description could be a more detailed version of the example in 2.]

Explaining productivity loss in brain storming teams

We have seen that on brainstorming tasks, groups produce more good ideas than any single member is likely to produce. However, a group of interacting individuals is likely to produce fewer good ideas than a "nominal" group, that is a group of comparable individuals who work independently and whose contributions are pooled. In this section, we consider how social psychological theories that account for processes losses might

apply to this phenomenon. We can use our understanding of the reasons for the process loss in this case to evaluate the likely success of the design of commercial brainstorming tools. In a subsequent section, we try to show how using Karau's and Williams theory of social loafing we might redesign other social-technical systems, like list servers or online discussion groups, where content is often under contributed.

There are three plausible explanations of why interacting groups produce fewer ideas than similar individuals when working independently—social pressure, social loafing, and production blocking. Social pressure and social loafing are examples of motivational problems, while production blocking is a coordination one.

There is evidence that all three processes frequently occur in groups of many kinds, including brainstorming groups. However, production blocking seems to be the major cause of production loss in interacting brainstorming groups. In this section we consider the evidence that leads to this conclusions and suggest how this attribution of causation has consequences for the design of group systems for brain storming.

Although there are many forms of social pressure, in the case of brainstorming one might expect that individual contribution may be inhibited because of evaluation apprehension—a individual's fear that others might think badly of him or her for coming up with silly or impractical suggestions. Osborne's (19xx) directions for successful brainstorming, which emphasize the nonjudgmental contributions in the early stages of brainstorming, tries to guard against this inhibitor {quote).

Social pressure in general and evaluation apprehension in particular reduces participant's willingness to contribute ideas in a brainstorming session. These is especially the case for people who represent minority points of view (Connonlley; McLoed) or where their ideas are especially controversial (ref). For example, Diehl & Stroebe (1987) directly manipulated evaluation apprehension among individuals who were brainstorming by telling some of them that their contributions would be judged by peers or expert judges (high evaluation apprehension) or not (low evaluation

apprehension). Individuals who expected judgment produced fewer ideas than those who did not, especially when the discussion topics were controversial.

To reduce evaluation apprehension, some researcher and some commercial brainstorming systems have introduced anonymity into brainstorming sessions. Experiments provide some evidence that anonymity can increase individuals' willingness to contribute in brainstorming sessions. Connolly, Jessup & Valacich (1990) examined the effects of anonymity and evaluative tone on the performance of 24 computer-supported 4-person groups. Participants in the non-anonymous groups were introduced to each other and their ideas were identified with their names, while those in the anonymous groups were not introduced and their contributions had no names attached. These researchers also manipulated the evaluative tone of the experiment, by having a confederate offer critical or supportive comments in response to others' contributions. They found a strong effect of evaluative tone, with groups containing a critical confederate generating X% more ideas; the effects of anonymity was weak, with the anonymous group producing X% more ideas than the identified group. Research by Cooper, Gallupe, Pallard and Cadsby (1998) showed anonymity raised the productivity in electronic brainstorming groups by between 10-20%. However, similar research by Jessup, Connolly and Galegpher (1990), Jessup and Tansik (1991) and Valacich, Nennis and Nunamaker, found that anonymous groups did not produce reliably more ideas than ones where members were identified.

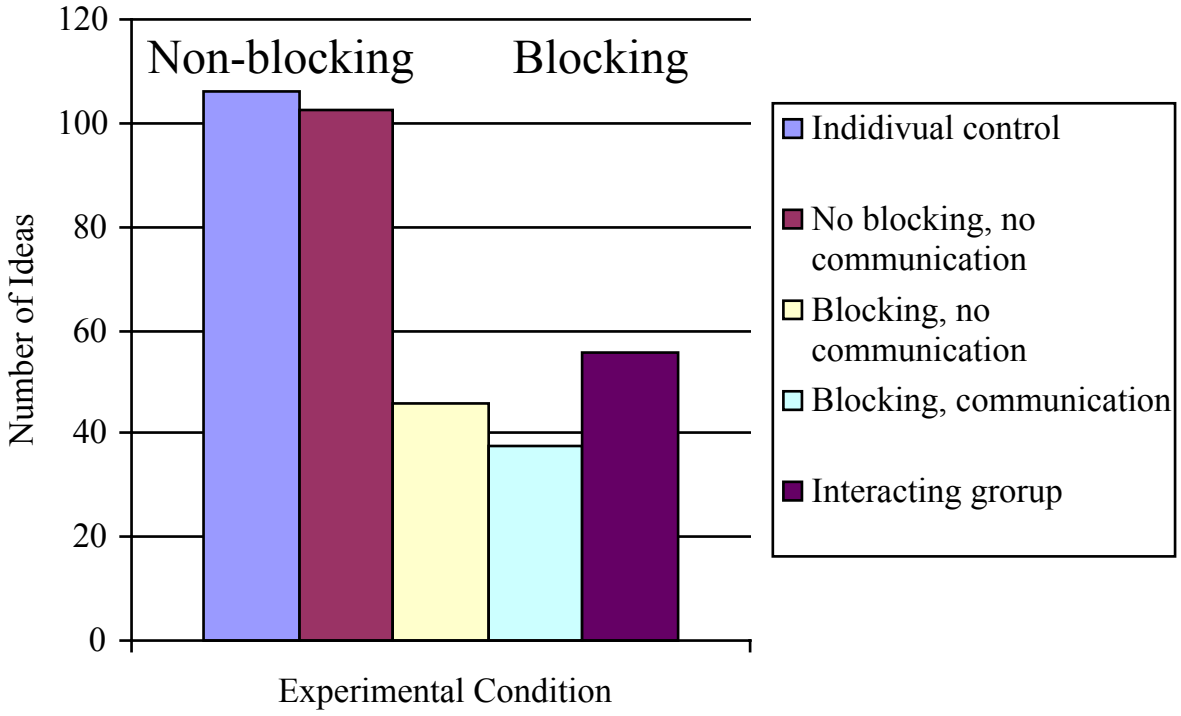
Does evaluation apprehension account for the productivity loss in brainstorming groups? To test this, one would need to show that the difference in brainstorming productivity between interacting groups and nominal groups is reduced when one controls for evaluation apprehension. Diehl and Stroebe (1987, experiment 4) conducted this test, by comparing brainstorming groups who believed their contributions would be judged by peers or experts (high evaluation apprehension) with those who thought their contributions would not be judged (low evaluation apprehension). They found that the high evaluation apprehension groups produced fewer ideas than the low evaluation apprehension ones, but only when they believed that the judgments reflected upon the

individual contributor rather than the group was a whole. However, regardless of the evaluation apprehension condition, nominal groups produced almost twice as many ideas as interacting groups. This pattern of results suggests that while evaluation apprehension inhibits the generation of ideas, it does not account for differences between nominal and real groups.

Social loafing might account for production loss in interacting brainstorming groups compared to pooling the contributions of individuals (nominal groups), because participants working in a real, interacting group might be less motivated to contribute. Social loafing does reduce brainstorming effort as it does many other outcomes. To test for the effects of social loafing, researchers typically compare co-acting individuals (i.e., ones where individuals work in the presence of others, but believe that their outputs will not be pooled) with true groups (i.e., ones where individuals work in each others presence and believe that their outputs will be combined). Research comparing these groups shows that social loafing reduces contribution in brainstorming tasks. For example, Diehl and Stroebe (1987, experiment 1) conducted a brainstorming experiment with two independent variables—type of session (individual versus real interacting 4-person group) and type of assessment (personal versus collective). In the personal assessment condition, participants were led to believe that their individual contributions would be tallied, while in the collective assessment condition, they were led to believe that the contributions would be pooled among all people in an experimental condition before being tallied. Collective assessment reduced contributions. Subjects in the collective assessment condition contributed about 76% of the number of ideas contributed in the personal assessment condition, showing the effects of social loafing. However, the effects of type of assessment where much weaker than the effects of being in a 4-person group or working individually. Subjects in the groups sessions contributed only 37% of the ideas of those in the individual sessions (i.e., what other researchers have called nominal groups). Moreover, the productivity loss from being in an interacting group was approximately the same whether subject thought their contributions would be evaluated individually or collectively. These results suggest that while social loafing can decrease

productivity for brainstorming tasks, it cannot account for differences between nominal and interacting groups.

All conventional, face-to-face brainstorming groups experience some degree of production blocking, because multiple members of the group cannot talk simultaneously without drowning each other out or interrupting each other. Therefore, to determine whether production blocking accounts for productivity losses in brainstorming groups, researchers have added production blocking to conditions under which blocking typically does not occur. For example, Diehl and Stroebe (1987, experiment 5) compared five experimental conditions. To replicate traditional research, they compared interacting groups and nominal groups (isolated individuals brainstorming independently). In addition, they included three other conditions, in which subjects believed they were in groups whose members were distributed in different rooms. Lights that glowed when other members of their distributed groups were talking regulated when they could talk, do different degrees.. In one condition, (blocking, communication), they heard the other people by headphones and were told to refrain from contributing when the red light was on. In the blocking, no-communication condition, they were told to refrain from contributing when the red light was on, but could not hear the other parties. In a non-blocking, no-communication condition, the red lights glowed when others were talking, but subjects were told that they could contribute"whenever they wanted and that they need not pay any attention to the lights." Results were consistent with the production blocking explanation, showing that both blocking manipulations reduced brainstorming performance over 50%, to the level of the interacting group, while seeing the lights without the blocking instruction had no effects on brainstorming.



Gallupe, Cooper, Grisé and Bastianutti (1994, experiment 3) used a similar approach. They compared two electronic brainstorming systems, in which people typed their contribution . In the electronic, non-blocking condition, participants could type in parallel and enter ideas simultaneously. In what they term the "electronic, first in" condition, subject could enter material only when a previous contributor had verbally indicated they had finished entering a previous idea. They compared these two electronic conditions with a conventional interacting, face-to-face brainstorming group, who spoke their contributions (face-to-face), and face-to-face group whose members had to wait until others were finished speaking before making a contribution (face-to-face, first in). Subjects in the electronic, non-blocking condition produced more about a third more non-redundant ideas than subjects in either of the other three conditions, which did not differ from each other.

These results suggest production blocking is the major cause for electronic groups to perform better than face-to-face interacting groups. Introducing blocking into both

distributed groups and into the electronic group eliminates the advantages of working independently.

Together the results of this research shows that evaluation apprehension, social loafing, and production blocking can all reduce production in brainstorming groups. However, production blocking seems to be the primary factor that explains why nominal groups (individuals whose contributions are pooled) typically produce more ideas than interacting groups.

Application to system design

Knowing which of these is the primary cause of production loss in brainstorming group has implications for designing effective brainstorming tools. If social pressure and evaluation apprehension are the major inhibitors, one design solution is to enforce anonymity in contributions. Disguising the identity of contributors should reduce their fears that others will think poorly of them for outlandish contributions and thereby reduce inhibition. As, Nunamaker, Dennis, Valacich, Vogel & George, 1991) note, "anonymity can affect EMS [Electronic Meeting Support] use by reducing or eliminating evaluation apprehensions and conformance pressures, as well as social cues. The reduction of evaluation apprehension and conformance pressure may encourage a more open, honest and free-wheeling discussion of key issues. (p. 55)." Based on this logic, most commercial meeting support systems, including those with electronic brain storming features, enforce anonymity. (e.g., www.GroupSystems.com).

In contrast, if social loafing is a major cause, then enforcing anonymity would be counter productive. Both theory and Karau and Williams' (19xx) empirical literature review suggest that making an individual's contributions visible decreases social loafing and encourages people to contribute. One type of positive social pressure in a group is to set a production standard. Knowing that other can observes and evaluate ones output discourages group members from slacking off, at the same time that it might discourage people from contributing outlandish or controversial ideas. Perhaps these conflicting

outcomes are the reasons why anonymity does not seem to have consistent effects on the quality and quantity of performance in brainstorming sessions.

Finally, if production blocking is the major source of the problem, then manipulating anonymity is irrelevant. Production blocking occurs when simultaneous contributions overtaxes some scare resource, such as time or working memory. Production blocking occurs because in face-to-face settings, two people can't talk at the same time or because the act of listing to others' contributions prevents an individual from simultaneously generating new ideas. If production blocking is the major cause, then the solution is to devise procedures or technologies that allow simultaneous input. Virtually every research-oriented and commercial group decision support system has a modual for electronic brainstorming and has procedures for simultaneous input. For example, xxx provides participants with a form, like an index card, which a participant can edit independently of other participants' contribution. When the card is submitted, it is appended to a list containing everyone's contributions, which the participant can read at his or her convenience. www.groupsystems.com uses a similar procedure. In their, xx module, a small number of lists of suggestions circulate among the participants. Each participant intitates a list, by making a contribution. When participants submit a contribution, they are randomly given a one of the circulating list, to which they can append an other new idea or a comment on a previous one. In both of these arrangements, multiple participants can contribute simultaneously. They also have an opportunity to see others' contributions, for potential intellectual stimulation this might provide.

Although we have used the phenomenon of production losses in brainstorming as a vehicle to understand the application of various social psychological theories, these theories are not limited to this domain. In the section below we discuss how a theory of social loafing might be used to increase contribution rates in various online communication forum.

5. Case Study (6-10 pages)

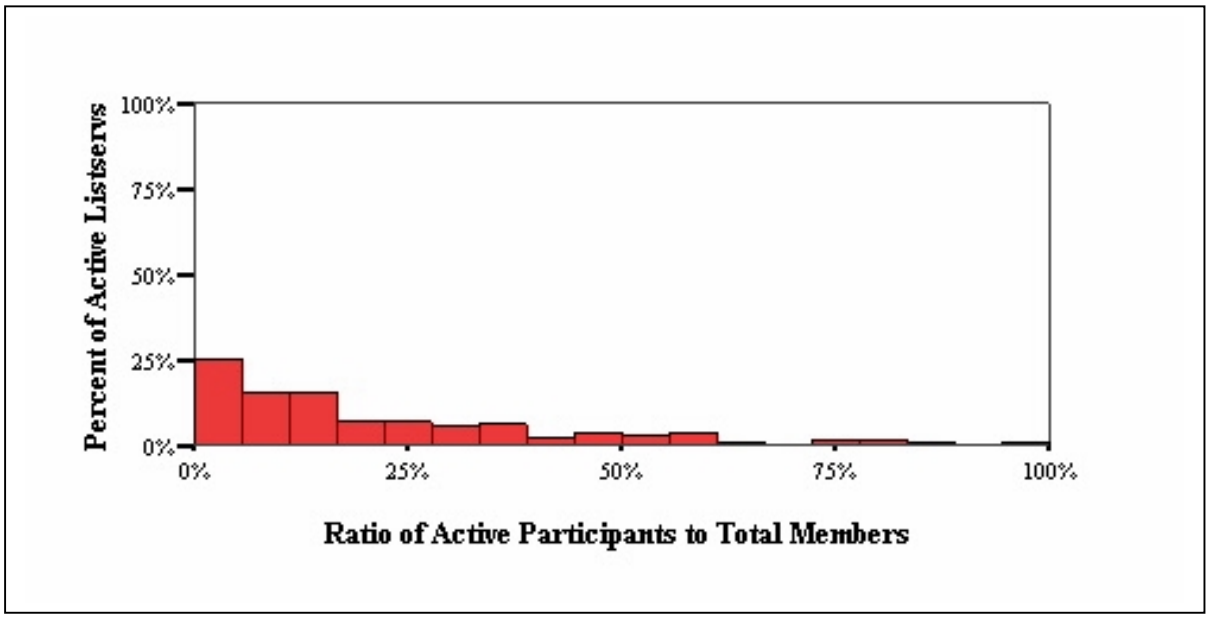
[Describe one or more examples in which the approach was used in design, evaluation, or other system development work. The description should leverage parts 3 and 4, referring to processes and concepts, rather than unpacking everything in detail. Ideally, this section can be written at an "advanced" level, modeling the kind of technical discourse that is possible when readers understand basic scientific concepts and theory-based techniques.]

Social loafing and online groups

One of the benefits of the Internet is its support of online groups and communities (Preece, 2000). The Internet supports computer mediated communication among groups of individuals, who may or may not have off-line relationships as well. People can communicate in near real-time, using both synchronous communication services, like MUDs, chats, and instant messaging. Alternatively, they can communicate without having to be simultaneously available, using asynchronous communication services, like electronic mail distribution lists, list servers, and electronic bulletin boards. For example, www.xxx.com provides a listing of xx email thousand distribution lists, a large proportion of which are open to the public. These online groups can be recreational, as are many Dungeons and Dragons-based MUDs or movie-fan based distribution lists. They can provide technical, product or hobby information, such as distribution lists for computers and programming languages. Many provide social support for their participants as well as information, such as health-oriented chats and distributions lists.

A fundamental characteristic of online groups is their highly uneven distribution of contributions. In almost all, a small fraction of the subscribers or members contribute most of the content, with the remainder acting as “lurkers” or subscribers who only read. Figure X distribution of contributions from a sample of 39 active email-based distribution lists on a wide variety of topics (Bulter, 1999). Over 50% of the individuals subscribing to these lists posted no messages at all, and in fewer than 10% of the lists do even 50% of

the subscribers contribute anything. The vast majority of messages were contributed by a small number of posters.



Imagine that your goal, as a sponsor of an email distributions list for cancer support, was to increase participation rates, so that more of the subscribers contributed. In some sense the problem of low contribution rates is a social dilemma, analogous to paying taxes or donating to public television. If no one contributed to these online groups, then the social benefit that members get from them would disappear.

As an exercise, one could take Karau and William's theory of social loafing and use it as the basis for design guidelines to increase participation rates in these groups. To my knowledge, no one has yet formally conducted such an exercise or built an online group based on these guidelines. Different existing online groups are consistent with these guidelines to various degrees. The proposal sketched in this chapter is admittedly speculative and should be treated as a form of testable hypothesis. Table X lists the variables that reduce social loafing, according to Karau and William's meta-analysis. The second column indicates how this variable is linked to Karau and William's collective effort theory. Remember that this theory says people will be motivated to work on a task to the extent that they perceive that their successful performance on the task will lead to an outcome that they find attractive. Finally, column three provides design

suggestions based on this variable. As an oversimplification we will treat thematically-oriented, synchronous systems like MUDs and MOOs, synchronous, unstructured systems like chats, and asynchronous bulletin boards and list servers as instances of online groups. We recognize, however, that there are important differences in the way they operate and probably important differences in the ways that the variables associated with social loafing will influence members' behavior.

Variable	Link to theory	Design implication (Examples)
Identifiably	Direct deterrent to loafing; Behavior is more directly connected to individual outcomes	Do not allow anonymity or aliases on the group.
Attractiveness of task	Increases the valance of individual outcomes	Provide opportunities for interactivity, because interactive communication is more attractive and less effortful than asynchronous communication. Sharply define the topic of the group, since this will recruit members interested in the topic. Do not constrain content of online communication, since free communication is more attractive (at least to sender).
Attractiveness of the group	Increases the valance of group outcomes	Sharply define the topic of the group, since this will recruit members who are similar to each other and help define group boundaries. Recruit members who have prior relationships outside of the group (e.g., organizational or geographic connection), because multiplex

		relationships are stronger than single-stranded ones. Develop management policy, norms, or tools to isolate unacceptable behavior.
Group size	Larger groups lower the probability that one's individual effort will lead to valued group outcomes	Place size limits or entry thresholds on new membership. Cull non-participants to reduce size of group. Split active groups into subgroups, to maintain small group size.
Uniqueness of own contribution	Intensifies probability that one's individual effort will lead to valued group outcomes	Mix members with different approach to same topics (e.g., MDs, the cured and currently ill on support groups), helping members to see their unique role.
Expectation that others will perform poorly	Intensifies probability that one's individual effort will lead to valued group outcomes	Mix novice and experts within a single group, making expertise more essential.

Table X: Design ideas for online groups based on a theory of social loafing

These suggestions in Table X are highly speculative and are intended to illustrate the generative power of social psychological theory. For the purposes of this illustration we are assuming that Karau and Williams' theory is a complete and accurate theory of social loafing. Whether the suggestions derived from this theory will in fact improve participation rates in online groups and the health of the group more generally depends upo four factors. First, are the suggestions an accurate derivation from the theory? Second, are they implemented well? Third, are there other factors besides social loafing, such as differential commitment to the group, that lead to the unequal participation rates, and will interventions that counters social loafing have a beneficial or at least neutral effect on these other processes? Finally, do the efforts to increase participation rates

effect other valued outcomes from the online group, such as communication volume, satisfaction that members get from the group, or their longevity with the group?

The discussion below fleshes out a few of the design suggestions in Table X in more detail. Consider suggestions related to increasing the attractiveness of the group. The empirical literature shows that social loafing is reduced when group members feel the group is more attractive. We can term this the "attractiveness principle." One can increase the attractiveness of a group either influencing members' connections to particular others in the group or by influencing their commitment to the group as a whole. A long standing topic in social psychology has been understanding the factors that lead to liking among individuals. For example, people typically like others who are similar to themselves, who are good looking, intelligent, or have other positive social attributes, who have provided them favors, and with whom they have a history of interaction, (see ref, 19xx, for a fuller discussion of the basis of interpersonal attraction.) Translating these principles into criteria for the design of online groups requires creativity. Because people like those who are similar to themselves, it follows that members of topically oriented groups will have their joint interest in the organizing topic as a basis for similarity. Thus, one might hypothesize that members would be more likely to form friendships with others who subscribe to a specific online groups with sharply defined topics, such as the usenet groups that concentrated on a particular soap opera (e.g., alt.tv.days-of-our-lives), rather than more general groups, that encouraged discussion of all soap operats on a particular network (e.g., rec.arts.tv.soaps.abc) Similarity is desirable in its own right and provides a basis for conversation on a wide variety of topics, through which additional bases for friendship might emerge. Since relationships that support a variety of exchanges (termed multiplex relationships) tend to be deeper and longer lasting than those based on a single type of exchange, list owners, who run online groups, should encourage wide ranging and hence oft-topic discussion, in their groups. This is the logic behind recommendations to define group membership sharply around a topic, but not moderate group or discourage off-topic conversation once people are members.

A second way to encourage members to increase their commitment to a group is to emphasis properties of the group itself, instead of the people who constitute it. For example, people feel more committed to groups that have clear boundaries which differentiate group members from outsiders (ref Tajfeld). This is another argument for constituting online groups with well-defined topics. People are more committed to groups for which they sacrificed to achieve membership (Aronson & Carlsmith, 19xx). Together, these first two principles suggest the design of oneline groups where members must be vetted by group owner or membership committee. Vetting would contrast with the practice in many discussion group, where joining is as simple as sending "SUBSCRIBE" in an email message. People like to affiliate more with high status groups that have achieved success (Cialdini, 19xx). Archives from a group and frequently asked questions lists that emphasized the group's accomplishments may help in this regard.

The social loafing research shows that people expend more effort on groups where they believe their own contributions are likely to be unique and other group members are less competent or skilled then they. Working through the implications of what we might call the "uniqueness principle" is substantially more difficult that working through the implication of the attraction principle. The practice in technical groups and health support groups of mixing experts with notices is consistent with the unqiueness principle. Finholt et al (19xx) showed that in one company, experts in a technical distribution list responded to "does anyone know" questions simply because they knew they had expertise that would be valuable to other subscribers. Most health support groups, like the usenet group alt.support.depression enourage participation by an ecology of participants with complementary resources. They consist of those who actively have a disease, those who have previously had it, those who are providing support for someone with a disease, and medical professionals. Each type of member provides unique contributions, ranging from questions about symptoms, diagnosis and treatment, to information about these topics, reports on subjective experiences, and expressions of concern and support. Some people become members of these groups to receive information and support, while others become and remain members to provide it.

To some extent, however, the uniqueness principle is at odds with the attractiveness principle. Online groups filled with novices are likely to turn off the experts, because they are so dissimilar, because their presence tends to detract from the stature of the group as a whole, and because the majority of exchanges in the group are likely to go from expert to novice. To keep these countervailing tendencies in balance, online groups often develop Frequently Asked Question (FAQ) archives to relieve the burden on expert from handling the most mundane questions. (See http://www.faqs.org/faqs/ for an index of FAQs for many usenet groups). Some researchers have attempted to create software that database lookup of information with advice from actual group members (e.g., Ackerman, answer garden), so that when experts are asked adviced they can be assured that their contributions are unique and haven't previously been asked and answered.

6. Current status (2-3 pages)

[What is the trajectory of the approach (at a high level)? For example, look at the progress and activity of the last decade and comment on the issues that will be important in the next decade. This could include tool support, engineering methods, extensions to new categories of systems and applications, and so forth.]

The thesis of this chapter has been that social psychology provides a rich about the principles of human behavior, which should be applicable to the design of HCI applications, especially applications to support multiple individuals communicating or performing some task. Simply put, as a discipline social psychologists know an enormous amount about how individuals form attachments to each other, how individuals make judgments of each other, how groups form and develop, and how groups organize to work together productively. Like the research reviewed here on social loafing, most tend to be mid-level theories, providing insight into a single aspect of human behavior in group, rather than being a general theory of groups in general. As in the case of the

research literature on social loafing, these theories of group behavior and behavior in groups have implications for the design of computer systems to support groups.

However, as Finholt notes (19xx), researchers and developers in the field of Human Computer Interaction have rarely taken advantage of this trove of empirical phenomena and theory. There are several reasons why this body of research has been under-exploited. First are the standard problems of disciplinary inbreeding. In CSCW, as in many fields, researcher tend to know about and therefore refer primarily to research reports published in the restricted set of journals, which they consider core to the discipline. As Finholt (19xx) notes, researchers in HCI and CSCW rarely explore the research literature outside of their own conferences. For example, XX percent of the references in the proceeding of the 2000 CSCW conference refer to articles published in CHI or CSCW proceedings. The primarily literature in cognitive psychology, sociology, anthropology as well as social psychology is rarely cited.

The other, major reason is the mismatch of goals and values of HCI and CSCW research with those of social psychology. HCI and CSCW are primarily engineering disciplines, whose primarily goal is in problem solving. In contrast, social psychology views itself as behavioral science, whose mission to uniquely determine the causes for social phenomena. Although researchers who identify with the behavioral and social sciences are active in these disciplines, they are active as applied scientists, importing ideas and methods from their home disciplines to solve design problems. The central value in HCI and CSCW, as in many engineering disciplines, is problem solving.

In this chapter, for example, we've considered how to solve the problem of members' failure to participate adequately in an online community. In solving a practical problem, it is likely that engineers will have to bring together many strands of knowledge. For example, in solving the problem of under-participation in online communities, those with an engineering ethic might bring together ideas from social loafing and the mere presence of other in social psychology with ideas from public goods in economics (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996). Public goods economics examines problems of collective action (Olsen, 19xx), such as people's unwillingness to

contribute to public television and other public programs or their over-readiness to pollute the environment. In these cases, behavior that is rational at the individual level has pernicious social consequences when many people make the same decision., a social psychologist's goal would be to distinguish the independent influence of these three factors. While s designer might combine knowledge from social loafing, mere presence, and public goods economics to solve the problem of under contribution, a social psycholist would most likely try to assess the independent influence of these factors. A standard research strategy in social psychology is to use experiments that allow the researcher to manipulate one potential causal agent at a time while holding all other variables constant. For example, theories of social loafing attempt to explain why individuals are less productive in groups than when working individually. To distinguish the effects of believing oneself part of a group from the effects of the mere presence of others, for example, social loafing research compares subjects performing some task in the presence of others under conditions where they believe that their output is pooled to conditions in which they believe their output will be kept separate. This strategy allows the researcher to identify one factor, such the pooling of output, as a true cause, even though in the world outside of the laboratory, other causes may also be present.

This research strategy of holding other influences constant while examining the impact of a variable of interest makes it difficult to compare the strength of effects of different causal agents. This problem is compounded in laboratory experiments, because the strength of an effect depends upon exactly how an experimenter operationalized a variable rather than upon how the variable is distributed in the world outside the laboratory.

In solving real design problems, contextual details are frequently important. For example, in solving the problem of under-contribution to online communities, the solution may depend upon whether the community is intended for adults or children, whether it has commercial or nonprofit content, or whether it uses an asynchronous technology, like email, or a synchronous one, like chat. In contrast, the norm in much social psychological research is to abstract these contextual details away. The goal is to

have a theory that is as general as possible. Thus a theory of social loafing, for example, is more successful to the extent that it holds for physical and mental tasks, that it applies to college students and adults, or that it applies to history-less laboratory groups and real-world groups, like swimming teams, with real histories. Refinement of theory often requires specifying conditions under which phenomena of interest occur. Thus the finding that social loafing is less likely to occur when people attracted to the group helps to define the theory. For a social psychologist examining social loafing, the source of the attraction should be irrelevant. However, to someone designing a real online community, whether a group is attractive because members are rich, intelligent or good looking, because they share a common interest, or because they are familiar with each other are crucial details.

A result of these fundamental differences between the values of problem-oriented designers and theory-oriented social psychologists is that the knowledge produced by the psychologists doesn't fit with the designers' needs. For example, it is often not detailed enough. As we have seen for example, social loafing is less likely to occur when members are attracted to a group. However, the research on social loafing does not provide guidance on how to make a group attractive, or the implication of different methods. We have also seen that social loafing is less likely to occur when members consider themselves unique. However, a participant's perceived uniqueness is likely to make the group less attractive to him or her. The social psychological research doesn't indicate which of these phenomena is more powerful. This lack of concreteness leaves the designer to improvise when attempting to apply social psychological knowledge to solve design problems. It is perhaps for this reason that when CSCW researchers turn to the social science literature outside of their own field, they are more likely to consult ethnographic research than experimental social psychology. Ethnographic research is filled with a wealth of concrete detail, often at the expense of generalizeability. From a study such as Orlekowski (19xx) one might learn how one company induced help desk personnel to contribute solutions to a shared database. Judging the generalizability of the conclusions is an exercise for the reader.

7. Further reading

ABC, 19xx

Ackerman, Mark S. 1992. The Answer Garden Substrate: A Platform for Building Organizational Memory Applications. Proceedings of the Workshop on Information Technologies & Systems (WITS 92) : 104-113.

Argyres, Nicholas S. (1999). The impact of information technology on coordination: Evidence from the B-2 'Stealth' bomber. Organizational Science, 10(2), 162-180.

Aronson, E. (1999). The Social Animal (8th Ed). NY: W H Freeman & Co

Baron, R. A., Byrne, D. E. (1999) Social Psychology (Ninth Edition). NY: Allyn & Bacon.

Barry Boehm, Bradford Clark, Ellis Horowitz, Chris Westland, Ray Madachy, Richard Selby (1995). "Cost Models for Future Software Life Cycle Processes: COCOMO 2.0," Annals of Software Engineering

Bong, W., Chang, C. & X, J. (Unpublished manuscript).

By Asch, S. E. (1948). The doctrine of suggestion, prestige and imitation in social psychology. Psychological Review. 250-276

Card, S., Moran, T., & Newell, A. (1983). The Psychology of Human-Computer Interaction. Hillsdale, NJ: Lawrence Erlbaum Associates.

Clark, Herbert H. & Brennan, Susan E. (1991). Grounding in communication. In L. B. Resnick, R. M. Levine, & S. D. Teasley (eds). Perspectives on socially shared cognition.. (Pp. 127-149). Washingtonton, DC: American Psychological Association.

Cramtom, C. D. (In press). The mutual knowledge problem and its consequences in geographically dispersed teams. Organizational Science.

Cummings, J. (2001). Knowledge sharing in teams. Unpublished doctoral dissertation. Department of Social and Decision Sciences, Carnegie Mellon University.

Fulk, J., Flanagin, A., Kalman, M., Monge, P. & Ryan, T (1996). Connective and communal public goods in interactive communication systems. Communication Theory, 6, 60-87.

Gigone, Daniel; & Hastie, Reid (1997). Proper analysis of the accuracy of group judgments. Psychological Bulletin. 121(1) 149-167

Gilbert, D. T., Fiske, S. T., Lindzey, G. (Eds.) (1998) The Handbook of Social Psychology. Oxford, UK. Oxford University Press.

Hackman, J.R. (1983) The design of work teams. In J.W. Lorsch (Ed.), Handbook of Organizational Behavior. Englewood Cliffs, NJ: Prentice- Hall, 315-342.

Hargadon, A. & Sutton, R. Technology brokering and innovation in a product development firm. (1997). Administrative Science Quarterly, 42, 716-749.

Hill, G. W. (1982). Group versus individual performance. Are N = 1 heads better than one? Psychological Bulletin, 91, 517-539.

Hogg, M. A. & Tinsdale, S. (Eds.), (2001). Blackwell Handbook of Social Psychology : Group Processes (Blackwell Handbook of Social Psychology) London, UK: Blackwell Publishers.

Hughes, John, King, Val Rodden, Tom, and Andersen, Hans . (1994). Moving out from the control room: ethnography in system design; Proceedings of the conference on Computer supported cooperative work, 1994, Pages 429 - 439

Kraut, R. E., Galegher, J., & Egido, C. (1988). Relationships and tasks in scientific research collaborations. Human-Computer Interaction, 3, 31-58.

Kraut, R. Fussell, S. R., Brennan, S E., and Siegel, Jkr. (In press). Understanding Effects of Proximity on Collaboration : Implications for Technologies to Support Remote Collaborative Work In P. Hinds & S. Kiesler (Eds.) Distributed Work. (pp. xx-xx). Cambridge, MA: MIT Press.

McGrath, J.E. (1984). Groups: Interaction and performance. Englewood Cliffs, NJ: Prentice-Hall.

Milgram, S. (1965). Some conditions of obedience and disobedience to authority. Human Relations, 18, 57-75.

Olson, Gary M. & Olson, Judith S. (In press). Distance Matters. Human Computer Interaction

Orlikowski, Wanda (2000). Using technology and constituting structures: A practice lens for studying technolgy in organizations. Organizational Science, 11(4), 404-428.

Preece, J. (2000). Online Communities.

Ross, E. A. (1908). Social Psychology. New York, MacMillan.

Roussev, Vassil, Dewan, Prasun & Jain, Vibhor. (2000). Composable collaboration infrastructures based on programming patterns; . Proceeding on the ACM 2000 Conference on Computer supported cooperative work, 2000, Pages 117 - 126

Sherif, M. (1937). An experimental approach to the study of attitudes. Sociometry, 90-98

Sherif, M. (1935, No. 187 60). A study of some social factors in perception. Archives of Psychology

Somerville, Ian (2001). "Software Engineering" 6th ed, Addison Wesley

Steiner, I.D. (1972) Group process and productivity. New York: Academic Press.

Suchman, Lucy A. (1983). Office Procedure as Practical Action: Models of Work and System Design. ACM Transactions on Office Information Systems, 1(4), 320-328.

Suchman, Lucy A. 1987. Plans and Situated Actions: The Problem of Human-Computer Communication. Cambridge University Press, New York.

Zajonc, Robert. B. 1965 Social facilitation. Science. 1965 149(Whole No. 3681) 269-274