HANDBOOK *of* NEW MEDIA

Social Shaping and Consequences of ICTs

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New Media and Organizing at the Group Level

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Traditionally, small groups have been defined by researchers as collectives ranging from a minimum of two, and in most cases three, to a maximum of 15 or so members (cf. McGrath, 1984). Members of groups have interdependent goals, are acquainted with and interact with one another and have a sense of belonging. Recent developments in digital communication technologies have brought about a radical change in our collective notion of what constitutes a group. Members of groups no longer need to be formally constituted or to be co-present (in time or place) to collaborate, share information or socialize. Instead new technologies facilitate the creation, maintenance and dissolution of groups among individuals who use different devices (such as phones, mobiles, laptops, personal digital assistants) to interact over one or more of a variety of channels (audio, video, text and graphics) offered by several forums (such as Internet newsgroups, online chat sessions via Instant Messenger, and corporate intranets). These developments have triggered a shift in conceptualizations of groups from the traditional notion of 'same time, same place' to 'any time, anywhere' and, some would argue apocryphally, 'all the time, everywhere'. In addition to the physical and temporal constraints, developments in new media have also eliminated constraints on the size of groups. In traditional face-to-face groups, the size of the group is likely to be relatively small and its membership is by definition a closed set. This is also true for some geographically distributed work teams that collaborate using communication technologies such as video and computer conferencing. However, that is not the case in many Internet-based newsgroups, where there are literally hundreds of participants (Alexander et al., in press). These participants may coalesce as a group because of a common 'practice', such as collaborating on the development of a software program, or because of a common 'interest', such as their concerns about the use of 'sweatshop' labour practices or their interest in downloading a particular genre of music. As a global community of consumers and producers we are grappling with the opportunities and challenges of these new fluid 'group forms' of organizing.

As researchers, we are challenged to redefine the theoretical and methodological apparatus to study how new media shape, and are in turn shaped by, the ways in which we organize in groups. Before the development of the World Wide Web and the Internet, research on groups with technological support was driven by three basic goals: to examine how adequately new media could permit groups to overcome time and space constraints, to evaluate the impact of technologies on the range and speed of members' access to information, and to evaluate the impact of technologies on the groups' task performance (McGrath and Hollingshead, 1994). Much of the theory and research addressed when and how the structure, interaction and performance of technologically enabled groups were similar to and different frotn face-to-face groups. As such, the focus of this research was on examining the ways in which new media served to substitute and enlarge communication among group members (Contractor and Bishop, 2000). With the surge in digital communication technologies, researchers started to

reckon with the idea that most technologically enabled groups were inherently different from face-to-face groups, and that they were worthy of study as entities in their own right rather than simply to be bench marked *against* equivalent face-to-face groups. Many of the premises of existing theories were being challenged by technological developments and risked becoming less relevant at best, and obsolete at worst. Researchers are currently rethinking their definitions of groups and are developing new theories to explain and predict their behaviour, and are designing new methods to study them.

This chapter examines the role of new media at the group level of analysis. Its emphasis is on how technology shapes and is shaped by the behaviour of groups, rather than on issues relating to the design of hardware and software systems for group collaboration. The organization of this chapter reflects the evolution in theory and research on groups and new media. As we shall see, the theory and research also reflects our evolving definitions of 'new media' – starting with early experiments in teleconferencing (audio and video conferencing) in the 1970s, and continuing with proprietary computer-mediated communication systems in the 1980s, the rise of the Internet and the web as 'open' communication networks in the 1990s, and the ubiquitous, pervasive and mobile communication environment that ushers us into the twenty-first century. The chapter begins with a brief description of an early, but influential, classification of technologies that support group interaction. The second and third sections examine the theory and empirical findings of research that investigated how technologically enabled group collaborations are similar and different from face-to-face collaborations. As will become evident, most of this research was conducted, or at least premised, on conceptualizations of groups prior to recent developments in digital technologies. The fourth section presents a reconceptualization of groups that takes into account the new forms of organizing enabled by new media. This reconceptualization allows for a more fluid, dynamic and activity-based definition of groups and technology, and is drawn from a network perspective. It presents a knowledge network approach to the study of groups and technology.

A Classification of Technologies that Support Groups

Collaboration among group members entails cognitive as well as emotional and motivational aspects of communication. Group members transmit, receive and store information of various kinds, from each other and from various other sources. These exchanges were viewed as distinct functions carried out by group members. Hence, not surprisingly, scholars conceptualized the technologies that support these functions to also be distinct. With an eye towards retrospective synthesis of research in this area, McGrath and Hollingshead (1993; 1994) presented a classification system for communication systems based on the functional role of technologies to support group collaboration. The four categories of the classification system are based on whether the technology: (1) provides within-group communication (i.e. group communication support systems or GCSS); (2) supplements information available to the group or its members by information drawn from databases (i.e. group infonnation support systems or GISS); (3) supports communication with those outside the group (i.e. group external support systems or GXSS); and (4) structures group task performance processes and task products (i.e. group performance support systems or GPSS). The classification system was developed in the early 1990s when the World Wide Web was in its infancy. It was later updated to include communication technologies available on the Internet (Hollingshend. 2001). While the classification system was developed at a time when distinct technologies supported these different functions, it continues to be a viable framework to organize and examine contemporary technologies that typically support more than one of these four functions.

GCSS: Technologies that Mediate or Augment Within-Group Communication

The signature feature of GCSS is its ability to permit group members to communicate using new media. In some cases GCSS may mediate communication among members spatially separated from each other while they are communicating. Examples would include video conferencing, or 'texting' using short-message service (SMS). In other cases GCSS may augment face-to-face communication by the use of overhead projectors for communicating graphics or document-sharing software over networked computers. Some GCSS support asynchronous communication for group members interacting in different time periods; others require that group members interact synchronously. As these examples illustrate, GCSS vary in the communication channels that are available to group members visual, auditory, text and graphics.

Most research on GCSS has been based on the premise that the fewer modalities afforded by technologically mediated communication would 'filter out some of the cues in face-to-face communication (Culnan and Markus, 1987). Based on this assumption, the research agenda sought to examine how the performance of groups using GCSS was moderated by the particular task(s) and activities in which rhe group was engaged, the experience of the group with the technology, and the degree to which group

Table 13.1 *A typology of group communication support systems*

Modalities available	Synchronous	Asynchronous
Visual	Video conference	Videocassette exchange
Audio	Phone conference	Voice mail Audiotape exchange
Text, graphics	Computer conference	E-mail Fax
Internet	Newsgroups Chat rooms	Home pages, websites

members have a shared conceptualization of relative expertise (Hollingshead, 1998a; 1998b; Hollingshead et al., 1993). In addition to examining the performance of groups using GCSS, some research has focused on the interaction process among group members. This research (McGrath and Hollingshead, 1994) has found evidence that the sequencing, synchrony and timing of messages among group members using GCSS is moderated by the size and nature of the groups, as well as the level of ambiguity among group members.

Table 13.1 provides examples of GCSS organized by the communication channels provided by the technology (video, audio, text/graphics) and the temporal distribution of members, i.e. whether they are communicating synchronously or asynchronously. As noted at the start of this section, GCSS can support communication between members who are co-present or are geographically distributed. However, as we shall see in the review of empirical research, the preponderance of research on GCSS has been among geographically distributed groups. Culnan and Markus (1987) argue that this bias reflects an early preoccupation with the role of GCSS to mediate rather than to augment face-to-face communication. The organizing scheme also includes categories for Internet technologies, although World Wide Web browsers can support video conferencing, audio conferencing and document sharing on the Internet.

GISS: Supplementing Information Available to the Group

Group members have access to many repositories of information or knowledge besides other group members. These repositories include databases, archives and intranets. Intranets are web-based technologies that support knowledge distribution among networks of teams within organizations. The types of knowledge that are available to group members on intranets can include: (1) human resources, (2) sales and marketing activities, (3) financial information, and (4) design and manufacturing specifications and innovations (Bar et al., 1098). Other examples of GISS are information management programs that organize schedules, files, contacts and other information on desktops to facilitate information exchange with other members. Microsoft Outlook, which comes preloaded on many PC-compatible computers, is one such information management program. More recent examples include software agents such as 'webbots', or web-based robots, that assist group members by providing them, in some cases proactively, with relevant information scanned from digital repositories.

GXSS: Supporting External Communication

The GXSS function is a special case of both the GCSS function and the GISS function. Communication between group members and key external 'human' agents can be done with any of the GCSS systems described above. At the same time, one can consider interaction with non-human agents (such as webbots) external to the group as accessing yet another kind of information database, thus making it a special case of GISS. Organizations are increasingly able to interconnect seamlessly the human agents and non-human agents on their intranets with those of their clients, partners, suppliers or subcontractors, via secure web-based 'extranets' (Barr et al., 1998). As such, extranets serve as a unified infrastructure for GXSS that reaches beyond the traditional organizational boundary or its digital analogue, the corporate 'firewall'.

GPSS: Modifying the Group's Task Performance

For several decades, researchers have designed and evaluated strategies to structure the interaction among group members in order to enhance their effectiveness. These strategies, often under the stewardship of a facilitator or supervisor, constrain and structure the communication, the task information available, and/or the form and sequence of task responses permitted and required of the group

Some examples of such strategies are brainstorming, the Delphi method and the nominal group technique (NGT) (for a summary, see McGrath, 1984).

More recently, technologically enabled group performance support systems (GPSS) have been deployed to assist with these strategies. An influential effort has focused specifically on technologically enabled strategies to enhance decision-making among groups. These GPSS are also called GDSS or group decision support systems (see Jessup and Valacich, 1993, for discussion). In the late 1980s and early 1990s, most GPSS were in the form of decision rooms specially equipped computer labs supporting synchronous groups with co-located members. Most groups used these systems to augment their face-to-face decisions. These systems varied as to the type of task support provided to groups, the size of groups that could use the system, and whether a trained facilitator was necessary to augment the GPSS. Those that provided direct task support for groups usually incorporated an array of 'modules', each of which structures a different subset of a group's tasks or different portions of the group process on a given project. For example, a GPSS might include tools or modules for electronic brainstorming; for structuring various forms of evaluation and voting (rating, ranking, weighing, pick one, pick any, etc.); for identifying stakeholders and bringing their assumptions to the surface; or for exchanging anonymous or identified comments on any or all topics. Efforts are under way to develop these systems to support asynchronous and synchronous groups on the Internet. More recently, GPSS have been designed to encompass more than just decision-making. Current efforts in the area of workflow management, enterprise resource planning and computer-supported cooperative work (discussed by Star and Bowker and others elsewhere in this volume) underscore efforts to enhance group performance beyond simply decision-making.

Theoretical Perspectives

Most prior theory and research have focused primarily on how groups using technology accomplished their tasks differently from groups without access to technology. More specifically, much of the early theory relevant to the study of groups and technology addressed how the interaction and performance of groups that were separated in space and time differed from face-to-face groups. This research centred on those technologies classified as GCSS. One set of theories dealt with the topic of media choice or media selection: how people make choices about different media to use in their communication with others. Another set dealt with the topic of media effects: how technologies can impact group interaction processes and group outcomes. A third stream of theorizing explored the interrelations between technologies and group interaction by attempting to integrate the arguments offered by media choice and media effects theorists. Specifically, adaptive structuration theory (AST) examined how the structures that are imposed by technologies recursively shape and in turn are shaped by group interaction. Most of the empirical investigations of this perspective were conducted with technologies classified as GPSS. Finally, the most current theory that relates to groups and technology deals with the complexity of group processes, and suggests that technology is only one of many factors that can influence group processes and outcomes.

Media Choice

Some of the earliest theoretical work on media choice was conducted before computer use was widespread, and hence dealt with communication systems other than computers. Short et al. (1976) proposed the *social presence model* to predict which media individuals will use for certain types of interactions. Social presence refers to the degree of salience of the other person involved in the interaction, and was therefore assumed to be an 'objective' dimension that could be calibrated by a researcher independent of the users. They hypothesized that media differed in their social presence, and that individuals are aware of and agree on this difference and use it as a basis of their media choice. For instance, they argued that on an objective scale, text-based communication has a lower social presence than video conferencing, which in turn has a lower social presence than face-to-face communication. Further they argued that individuals would select a communication medium that had a social presence commensurate with the task they were trying to accomplish. Specifically, they predicted that individuals avoid a given medium for a given type of interaction if they perceive that medium as not providing a high enough degree of social presence for that type of interaction. They also predicted that communication using media low in social presence would be more appropriate for task-related communication while media high in social presence, such as fact-to-face communication, were more appropriate for transacting interpersonal (or socioemotional) content,

Daft and Lengel (1986) extended the ideas embodied in the social presence model in their theory of *media richness*. They proposed that different forms of communication differ in the 'richness' of the information that they provide, Richness was defined as the ability of a medium to provide multiple cues (verbal and non-verbal), and immediate (or quick) feedback, using multiple modalities

(text, video, audio and graphics). Based on these criteria they arrayed the various media from very lean (company policy manuals for rules and regulations) to lean (formal information systems) to somewhat rich (direct contact) to very rich (group meetings). Further, they argued that the various infonnation processing tasks conducted by group members could also be objectively arrayed in terms of their equivocality and uncertainty. Some communication tasks, such as finding the latest sales figures, entailed reducing uncertainty (that is, finding the right answer to a question). Other tasks, such as crafting a sales strategy, required reducing equivocality (that is, determining what is the right question to answer). Media richness theory proposed that 'rich' media were more appropriate to reduce equivocality and 'lean' media were more appropriate to reduce uncertainty. Daft and Lengel argued that managers use (and should use) different communication methods of appropriate degrees of richness to deal with situations that differ in equivocality and uncertainty. Hence, different communication media, or structural mechanisms in their terminology, need to be used for different types of organizational tasks. The more equivocality a situation involves, the richer the information required to deal with it. They presented seven structural mechanisms ordered along an information richness continuum based on capacity for resolving equivocality versus reducing uncertainty. The seven mechanisms included: group meetings, integrators, direct contact, planning, special reports, formal infonnation systems, and rules and regulations.

At the time media richness theory was first proposed, e-mail was not widely available in organizations; however, this theory was featured quite prominently in early empirical research that addressed predictors of e-mail usage in organizations. It was argued that managers whose choice of media reflected the equivocality or uncertainty of the task were perceived to be more competent. Some researchers (Trevino et al., 1990) found support for this argument, but many others did not (e.g. El-Shinnawy and Markus, 1997). One of the early criticisms of the model was that, like social presence theory, it assumed that media richness was considered to be an objective dimension; that is, each medium provided the same amount of richness, predetermined by the inherent attributes of the technology, regardless of who was using it (Culnan and Markus, 1997). Other scholars proposed that media richness was a subjective dimension. For example, e-mail may be perceived as a richer medium by people experienced with that technology than by those who are not. Still others noted that most tasks involved varying degrees of uncertainty and equivocality and that it was often not feasible to parse the task into subtasks that were unifonnly high or low in terms of their uncertainty or equivocality. As such, for these unbundled tasks it did not make much sense to dictate the use of lean or rich media.

Social presence theory and media richness theory were influential early attempts to understand media choice among group members. The lack of consistent empirical support for these theories was attributed to the theories' assumptions about ascribing objective attributes (social presence or media richness) to different communication technologies. As a result, alternative media selection theories were put forward that could account for these inconsistent findings.

One such theoretical formulation was the *social influence model.* Fulk et al. (1990) contended that the media richness model is more normative than descriptive of communication patterns in organizations. They argued that individual perceptions of the information richness of various media can vary, and that it was important to measure those perceptions rather than to rely solely on an objective assessment. They contended that objective features of media richness can and do influence individual perceptions of media richness, but there are other sources of such influence, such as social interaction. Drawing upon earlier research on social learning theory and social information processing theory, they argued that social interaction in the workplace shapes the creation of shared meanings. and that those shared meanings provide an important basis for shared patterns of media selection (Fulk et al., 1990; Schmitz and Fulk, 1991).

The social influence model hypothesized that media perceptions and use: (1) are subject to social influence; (2) may be subjectively or retrospectively rationalized; (3) are not necessarily aimed at maximizing efficiency: and (4) may be designed to preserve or create ambiguity to achieve strategic goals. Schmitz and Fulk (1991) found that perceived (as distinct from objectively defined) e-mail richness predicted individuals' e-mail assessments and usage and that the opinions of colleagues influenced others' media assessments. These results supported the notion that other group members can influence how individuals perceive and use technology.

The social influence model of media selection explicitly recognized the role of group members' communication networks in shaping their perception of media richness. An important implication, not addressed by the social influence theory, was how media selection in turn influenced the subsequent structure of the communication network itself (Contractor and Eisenberg, 1990). For instance, group members may be socially influenced by other members in their primarily face-to-face communication network to begin using e-mail. However. once these members begin to use e-mail, the new contacts available through this new medium may enlarge and possibly modify their pre-existing communication network. That is, it is possible that the

networks that socially influence individuals' media choices may in turn occasion a restructuring in their communication network. In essence, this observation points to a 'media effect' resulting from a 'media choice'. The following section describes an influential stream of research on the effects of media use on groups.

Media choice theories may be rendered less relevant today by developments in technologies. Increasingly, the convergence to a unified multimodal (audio, video, text and graphic) forum for communication makes interest in the distinctions between media, and hence the question of media choice, obsolete. Unlike the context in which media selection theories were developed, today it is increasingly plausible – even probable – for group members to simultaneously communicate via multiple modalities through a single device. An example would be the use of the web page to simultaneously communicate via audio and video, while sharing a document, and jointly executing a graphic simulation.

Media Effects

Hiltz and Turoff (1978) were among the first to describe differences between face-to-face and computer-mediated interaction in terms of social and psychological processes, and to discuss the importance of task-media contingencies. Hiltz and Turoff argued that groups communicating via computer had access to a narrower band of communication than groups communicating face-to-face. For example, non-verbal communication and paralanguage either were not available or were substantially reduced in computer-mediated communication. In some situations, such narrowband communication allowed information to be communicated with more precision and less noise, and afforded the opportunity for rational judgement processes to operate in the group with less intrusion of non-rational considerations. In other situations, computer conferencing needed to be supplemented by other media in which non-verbal communication and paralanguage were available. They were also among the first to present empirical findings that explored the effects of computer conferencing on the distribution of participation among members, on the amount of task and social communication, and on user responses to the availability and their satisfaction with the system (Hiltz et al., 1986).

Kiesler et al. (1984) provided a theoretical rationale as to why and how groups will differ when they use computer-mediated as compared with face-to-face communication. They proposed that computer-mediated communication depersonalizes the interaction process, with several concomitant effects. Individuals tend to lose mental sight of their interaction partners. At the same time, they lose access to a variety of cues that provide feedback to members regarding the impact of their behaviour on interaction partners, their status and their individuality. Thus, computer-mediated communication removes substantial social information and eliminates much of the feedback that people ordinarily communicate to one another face-to-face. This can have both positive and negative influences on the interaction processes, task outcomes and responses of users (Sproull and Kiesler, 1991).

People feel less inhibited when interacting through a computer network as a result of the reduction in social cues that provide information regarding one's status in the group. Therefore, participants concentrate more on the messages and less on the persons involved in the communication. Individuals feel less committed to what they say, less concerned about it, and less worried about how it will be received by their communication partners. Because people communicating electronically are less aware of social differences, they feel a greater sense of anonymity and detect less individuality in others. As a consequence, individuals engaged in computer-mediated group interaction tend to:

1. feel more anonymous and detect less individuality in their communication partners;
2. participate more equally (because low-status members are less inhibited);
3. focus more on task and instrumental aspects and less on personal and social aspects of interaction (because the context is depersonalized);
4. communicate more negative and more uninhibited messages (because they are less concerned with politeness norms that tend to regulate communication in face-to-face groups); and
5. experience more difficulty in attaining group consensus (both because of elimination of much interpersonal feedback, and because of reduced *concern* with social norms).

All of these effects have been demonstrated empirically (for review, see Kiesler and Sproull, 1992), and will be revisited in greater detail later in this chapter.

McGrath and Hollingshead (1993; 1994), building on the work described above and applying it to work groups, maintained that group interaction and performance are greatly affected by the type and difficulty of the task that the group is performing, and that the effects of technology on group interaction and performance interact with task type. They hypothesized that the effectiveness of a group on a task will vary with the fit between the richness of the information that can be transmitted using that system's technology and the information richness requirements of the group's task. However, as groups developed more experience with a given communication technology, the richness of the information that could be transmitted effectively via that technology would increase.

McGrath and Hollingshead posited that group tasks differed in their information richness requirements. Information richness referred to how much the information contains surplus emotional, attitudinal, normative and other meanings, beyond the literal cognitive denotations of the symbols used to express it. They also posited that communication media differed in the richness of the information that they can and do convey. Face-to-face communication among interpersonally involved humans was the richest medium; communication in written form among strangers was the least rich. Computer communication among group members inexperienced with the technology is at the low-richness end of that continuum.

Drawing from McGrath's (1984) task typology, McGrath and Hollingshead hypothesized that groups working on generate tasks (e.g. simple brainstorming tasks) do not require the transmission of evaluative and emotional content. As a result, computer-supported groups may brainstorm more effectively than face-to-face groups. At the other end of the continuum, groups negotiating and resolving conflicts of views or interests may require the transmission of maximally rich information, including not only 'facts' but also values, attitudes, emotions, etc. As a result, groups interacting face-to-face should perform such tasks more effectively than groups interacting via computer. In between the two ends of the continuum are intellective tasks that have a correct answer or decision-making tasks that do not have a correct answer, which may require some intermediary level of information richness. The predictions for generate tasks and negotiation tasks received empirical support (Gallupe et al., 1991; Hollingshead et al., 1993; Valacich et al., 1994), but not those for intellective and decision-making tasks (Hollingshead et al., 1993; Straus and McGrath, 1994).

McGrath and Hollingshead (1994) also predicted that communication technologies could provide information of increasing richness over time, as groups learned how to embed additional emotional, attitudinal, normative and other meaning through continued experience.

In summary, the theoretical arguments reviewed in this section offer three related perspectives on how technologies may influence the processes and outcomes of groups. While they vary in their levels of sophistication and theoretical complexity, all three theoretical approaches to media effects are based on the premise that technological attributes of different media influence key aspects of the interaction process. These key aspects include the availability of non-verbal cues, the potential for anonymous contributions, the ability to communicate status differentials, and the information richness of the medium. These key aspects in turn helped or hindered the group's interaction process (such as amount of participation, distribution of participation and negativity in communication on 'flaming'), as well as the group's outcomes (such as consensus, accuracy and speed of decision-making).

As such these theoretical perspectives on media effects acknowledge a modicum of technological determinism. Not unlike the media choice theories of social presence and media richness, discussed in the previous section, the theories of media effects described in this section do not privilege a socially constructed explanation for understanding media effects. The following section offers a theoretical framework that explicitly recognizes the social nature of technology and advocates an inextricable interrelatedness between media choice and media effects.

Adaptive Structuration Theory

Adaptive structuration theory (AST), proposed by Poole and DeSanctis (1990) and inspired by the influential theoretical contributions of Giddens' (1984) structuration theory, stresses the importance of group interaction processes, both in determining group outcomes and in mediating the effects of any given technology. Essentially, a social technology presents a structure of rules and operations to a group, but the group does not passively choose the technology in its pre-existing form. Rather, the group actively adapts the technology to its own ends, resulting in a restructuring of the technology as it is meshed with the group's own interaction system. Thus, a technology can be thought of as a set of social practices that emerge and evolve over time.

From this point of view, the structure of a group is not a permanent, concrete set of relations between members and their tasks. Rather, the structure is an evolving set of rules and resources available to them to produce and reproduce the apparently stable interaction systems that we observe. Thus, there is a recursive process between the structures (or the rules and resources in a group) and the systems (the interaction patterns in the groups). The rules or resources in the group shape the interactions patterns among group members. The interaction patterns among the group members, in turn, reify or subvert the rules and resources in the group. This recursive process is called adaptive structuration.

The rules and resources that groups use in the structuration process are sometimes created on the fly by the group, but more often they are *faithfully appropriated* by the group based on the social context in which it is embedded. *Appropriation* is the process by which a group selects features of a technology and socially constructs their meaning. It is through such appropriation that a group can choose to use a new technology. In some cases the group may not appropriate a technology in ways that were

intended by the designers of the technology. This situation is referred to as an *ironic appropriation*. For instance, a group may have access to a group decision support system (GDSS) that provides them with an opportunity to vote on their ideas. The voting tool is intended by the designers of the technology to facilitate democratic deliberation among group members. However, in some instances members of a group may use the voting tool to prematurely close off discussion of an issue. This action would illustrate an ironic appropriation of the GDSS. By faithfully or ironically appropriating a technology, each group invests meaning in, and thereby adapts for its use, the rules and resources that it draws upon. Both technology and context affect group processes and outcomes because they affect this appropriation process.

Empirical research has shown that different, but seemingly similar, groups appropriate the same technology in different ways (DeSanctis and Poole, 1997; Poole and DeSanctis, 1992; for a review see DeSanctis and Poole, 1994). Zack and McKenney (1995) offer a recent example of work in this tradition They examined the appropriation of the same group authoring and messaging computer system by the managing editorial groups of two morning newspapers owned by the same parent corporation. Drawing upon Poole and DeSanctis' (1990) theory of adaptive structuration, they discovered that the two groups' appropriation of the technology, as indexed by their communication networks, differed in accordance with the different contexts at the two locations, Further, they found evidence that the groups' performance outcomes for similar tasks were mediated by these interaction patterns.

Adaptive structuration theory continues to be an increasingly influential perspective to understand the socially constructed ways in which groups' choice of media and the effects of media on groups coevolve. It provides a powerful analytic framework to account for stability and change in a group's appropriation of new media. While the utility of a structurational perspective to the study of groups' use of new media is compelling, there continues to be a debate about the extent to which empirical studies offer a 'test' as opposed to an illustration of structuration theory's ability to explain the unfolding of complex processes (DeSanctis and Poole, 1994). Indeed, in a review of empirical studies from a structurational perspective, one would be hard pressed to identify a single work which failed to find support for adaptive structuration theory. Such overwhelming endorsement of a theory belies an underlying concern about the potential falsitiability of the theory. An appropriate challenge therefore would be to come up with specific predictions from the theory that, if they were not empirically validated, would plausibly represent a refutation of the premises of adaptive structuration theory. Complexity theory, discussed in the next section, offers a novel and useful approach to translate the richly evocative, but highly abbreviated, verbal explications of adaptive structuration theory into precise, falsiliable hypotheses that can be empirically validated (Poole, 1997).

Groups as Complex Systems

In the past decade there has been a plethora of scholarship calling for the extension of complexity theory – arguably a mainstay of many disciplines in the physical and life sciences – to social sciences in general, and to the study of groups in particular (Arrow et al., 2000; Contractor and Seibold, 1993; Contractor and Whitbred, 1997; Gersick, 1991: McGrath, 1991). The motivation for this call stems from a widely shared frustration with extant theories, which have proven to be inadequate at untangling with precision the complexity in group processes. The phenomena described in verbal expositions of, say, adaptive structuration theory invoke a multitude of factors that are highly interconnected, often via complex, non-linear, dynamic relationships. Lamenting the failed promise of earlier forays into systems theory, Poole notes, 'Most often, systems theory became a metaphor, rather than an instrument of analysis' (1997: 50). Two streams of research that attempt to go beyond the use of complexity theory as a metaphor (Contractor, 1999) have been developed to deal with the complexity of groups' use of new media: groups as self-organizing systems (Contractor and Seibold, 1993; Contractor and Whitbred, 1997) and groups as complex, adaptive and dynamic systems (Arrow et al., 2000).

Groups as Self-organizing Systems

In general terms, 'self-organizing systems theory (SOST) seeks to explain the emergence of patterned behaviour in systems that are initially in a state of disorganization. It offers a conceptual framework to explicitly articulate the underlying generative mechanisms and to systematically examine the processes by which these mechanisms generate, sustain and change existing structures or elaborate new structures' (Contractor and Seibold, 1993: 536).

llya Prigogine and his colleagues proposed the theory of self-organization. In an effort that contributed to a Nobel Prize, Prigogine and his colleagues (Glansdorff and Prigogine, 1971) mathematically proved that systems that exhibit emergence of spontaneous order must meet the following logical requirements:

1 At least one of the components in the system must exhibit autocatalysis, i.e. self-referencing.
2 At least two of the components in the system must be mutually causal.

3 The system must be open to the environment with respect to the exchange of energy and matter.
4 The system must operate in a far-from-equilibrium condition.

These four requirements offer, at a very abstract level, the conditions under which any system can self-organize. Our interests here are in applying these concepts to the study of groups using new media. Contractor and Seibold (1993) developed a self-organizing systems model for groups' use of group decision support systems (GDSS). They developed a model based on the theoretical mechanisms specified by adaptive structuration theory (Poole and DeSanctis, 1990; discussed in the previous section) about the recursive interrelationship behveen the structures (the rules and resources within the group) and the systems (the interaction patterns among the group members). Contractor and Seibold (1993: 537-8) specified four generative mechanisms that were consistent with the theoretical tenets of adaptive structuration theory and met the logical requirements of self-organizing systems theory:

1 Members' expertise (or resources) with the task will reinforce the content and pattern of their communication during GDSS-based discussions.
2 The content and pattern of members' communication will reinforce their perceptions of the group's norms for structuring the GDSS-based discussion.
3 Members expertise (or resources) with GDSS will reinforce their perceptions of the group's norms for structuring the GDSS-based discussions.
4 Members' perceptions of the group's norms for structuring the GDSS-based discussion will reinforce the content and pattern of their communication.

Using simulations, they showed that based on these four theoretical mechanisms the group's use of GDSS would self-organize only under a very specific range of initial conditions. A group using GDSS was considered to have self-organized when the group's structures (that is, its members' perceptions of the rules) were stable and the group members' interaction patterns were reproducing and reinforcing (rather than subverting) these stable structures. The simulation also provided precise conditions under which the groups would *not* successfully appropriate the technology. That is, the group might initially attempt to use the technology but would then discontinue its use. These results, theoretically grounded in adaptive structuration theory and logically consistent with self-organizing systems theory, represent plausible occurrences in groups' use of new media. They also respond to one of the criticisms levelled against adaptive structuration theory by making its explanations more amenable to falsification. In general terms, the approach illustrates how self-organizing systems theory can offer the logical conditions and the analytic framework to discover precise, empirically falsifiable hypotheses about the use (and lack thereof) of new media by groups.

Groups as Complex, Adaptive and Dynamic Systems

Arrow et al. (2000) have proposed a general theory of complex systems, which embeds technology as one aspect of the system. This theory builds on the time interaction and performance (TIP) theory proposed by McGrath (199 1). TIP theory assumes that groups pursue multiple functions for multiple projects by means of complex time/activity paths. Arrow et al. (2000) extend this theory by proposing that all groups act in the service of two generic functions: (1) *to complete group projects* and (2) to *fulfil member* needs. A group's success in pursuing these two functions affects and depends on the viability and integrity of the group as a system. Thus, *maintaining system integrity* becomes a third function, instrumental to the other two. A group's system integrity in turn affects its ability to complete group projects and fulfil member needs.

Groups include three types of elements: (1) people who become group *members*; (2) goals that are embodied in group *projects:* and (3) resources that get transformed into group technologies. Technologies differ in how much they facilitate or constrain interpersonal activity, task activity and procedural activity; and in how effectively they support different instrumental functions (i.e. processing of information, managing of conflict and consensus, and motivation, regulation and coordination of member behaviours).

A group pursues its functions by creating and enacting a coordinated pattern of member–task-tool relations, its *coordination network.* The full coordination network includes six component networks: (1) the *member network,* or pattern of member-member relations (such as status relations); (2) the *task network,* or pattern of task-task relations (e.g. the required sequence for completion of a set of tasks); (3) the *tool network*, or pattern of tool-tool relations (e.g. the procedure by which a technology can be used most efficiently); (4) the *labour network,* or pattern of member-task relations (i.e. who is supposed to do what); (5) the role *network,* or pattern of member-tool relations (i.e. how members do their tasks); and (6) the *job network*, or pattern of task-tool relations (e.g. what piece of equipment must be used for a given task).

The life course of a group can be characterized by three logically ordered modes that are conceptually distinct but have fuzzy temporal boundaries:

formation, operation and *metamorphosis.* As a group forms, people, intentions and resources become organized into an initial coordination network of relations among members, projects and technology that demarcates that group as a bounded social entity. As a group operates over time in the service of group projects and member needs, its members elaborate, enact, monitor and modify the coordination network established during formation. Groups both learn from their own experience and adapt to events occurring in their environment. If and when a group undergoes metamorphosis, it dissolves or is transformed into a different social entity.

Overview of Major Empirical Findings

A number of scholars have written literature reviews that examine communication technologies and groups (e.g. Benbasat and Lim, 1993; Hollingshead and McGrath, 1995; Kiesler and Sproull, 1992: Kraemer and Pinsonneault, 1990; McGrath and Hollingshead, 1994; McLeod, 1992; 1996; Seibold et al., 1994; Williams, 1977). Most of these reviews have compared the interaction processes and outcomes of computer-mediated groups with those of face-to-face groups. Several of those reviews have reached the same conclusions about the state of knowledge in this area: namely, that more theory-guided and programmatic research is needed (e.g. Hollingshead and McGrath. 1995; McLeod, 1992).

Interaction Patterns

Many studies have revealed that groups interacting via computers have more equal participation among members than groups interacting face-to-face (e.g. Clapper et al., 1991: Daly, 1993; Dubrovsky et al., 1991; George et al., 1990; Hiltz et al., 1986; McLeod, 1992; Rice, 1984; Siegel et al., 1986; Straus, 1996; Straus and McGrath, 1994; Zigurs et al., 1988). As described earlier, the general explanation for the effect is that people feel less inhibited when interacting through a computer network as a result of the reduction in social cues that provide information regarding one's status in the group. Because people communicating electronically are less aware of social differences, they feel a greater sense of anonymity and detect less individuality in others (Sproull and Kiesler, 1991). It is important to note some common elements across this set of studies. These studies were conducted during one experimental session with *ad hoc* groups consisting of students in a laboratory setting. However, it is also important to note that this finding was observed across a variety of communication technologies.

Many studies have also showed no evidence of the participation equalization effect in computer-mediated groups (Berdahl and Craig, 1996; Hollingshead, 1996b; Lea and Spears, 1991; McLeod and Liker, 1992; McLeod et al., 1997; Saunders et al., 1994; Spears and Lea, 1992; Watson et al., 1988; Weisband, 1992; Weisband et al., 1995). In fact, most showed that status differences among participants were displayed in their interaction in the computer-mediated setting. One explanation for the inconsistency of findings across studies is that status differences among members within the groups may have been differentially salient across studies. When members' identities were known or were available visually, the status differences in the number of contributions and the perceived influence of those contributions were maintained in the computer-mediated setting. When they were not or when members' contributions were anonymous, the participation equalization effect was more likely to occur.

It is also possible that the participation equalization may be an indication of how the medium reduces the baseline of each member's participation rather than how the medium leads to increased participation of low-status members during the group discussion (McGrath and Hollingshead, 1994; Spears and Lea, 1994). It takes more time to type a message on a computer network than it does to say that same message verbally. In the experiments cited above, the computer sessions were at least as long as those face-to-face group meetings; however, the amount and the rate of communication in the computer-mediated setting were much less. Another possible technological explanation for greater egalitarian participation patterns in computer-mediated settings is that electronic group members have the ability to participate without interruption, since turn-taking is not a norm in a computer-mediated environment (Weisband et al., 1995).

A number of studies have found that computer-mediated groups exchange less information and are less likely to repeat information in their decisions than face-to-face groups (Hollingshead, 1996a; 1996b; McLeod et al., 1997; Straus and McGrath, 1994). In some cases, this reduction can lead to poorer outcomes for newly formed groups (cf. Hollingshead, 1996a; 1996b).

Performance

Very few studies have demonstrated that groups communicating via computer perform better than groups interacting face-to-face, although many have demonstrated that computer-mediated groups perform less well than or equally well as face-to-face groups (for reviews see McGrath and Hollingshead, 1994; McLeod, 1992; 1996). Even

though computer-mediated groups generate less communication and use less information in their decisions, they take longer to make them (Hollingshead, 1996a). They are also less likely to reach consensus (for reviews see Hollingshead and McGrath, 1995; Kiesler and Sproul, 1992).

As described earlier, there seems to be an interaction effect of task and technology on the quality of group performance. Computer groups produce more ideas of higher quality on idea generation tasks. Face-to-face groups tend to have higher-quality products on intellective and negotiation tasks. However, it may be the structure that is imposed by the technology rather than the technology itself that is responsible for this effect (Hollingshead and McGrath, 1995). The task structure may include: procedures that simplify the handling of complex information; procedures that explicate agenda, thus making group process more organized; and procedures that expose conflict and help the group to deal with it. Some research showed that a paper and pencil version of the task structure imposed by the technology (i.e. without electronic communication) gave higher-quality decisions than the same task structure provided by a GPSS, which in turn was higher than the no-structure face-to-face condition (Hollingshead and McGrath, 1995; Watson et al., 1988). In some cases, newly formed groups on computers may have problems with task structure that requires more complex information processing (Hollingshead, 1996a).

Longitudinal research comparing the impact of computer-mediated and face-to-face communication over time has brought into question previous findings of significant differences in performance between face-to-face and computer-mediated groups. That research has shown that computer-mediated communication hinders the interaction process and performance of groups initially, but over time, groups can adjust successfully to their mode of communication (see McGrath et al., 1993 and Arrow et al., 1996 for overviews). In addition, work on the interpersonal and relationship aspects of computer-mediated communication over time complements this finding. Walther and Burgoon (1992) showed that members of computer-mediated groups felt less connected to one another initially, but over time, members of computer-mediated groups expressed more positive feelings about one another that approximated those expressed by members of face-to-face groups. The transient effects of technology were also illustrated in a longitudinal study comparing the developments of norms in groups using GDSS with groups not using GDSS. Contractor et al. (1996) found that while members of non-GDSS groups were initially more likely than members of GDSS groups to socially influence one another's perceptions of the group's norms, this difference dissipated over time. That is, in the long term, groups using GDSS were no more likely than groups not using GDSS to socially influence one another's perceptions of the groups' norms.

THE RECONCEPTUALIZATION OF GROUPS AND NEW MEDIA AS KNOWLEDGE NETWORKS

While it should be evident that the study of groups and new media is a vibrant area for research, we now return to the opening statements of this chapter about the theoretical and analytic challenges that confront scholars who consider the ways in which the 'new' new media of the twenty-first century will influence our ability to organize in groups. In conclusion, we offer a reconceptualization of groups' use of new media from a knowledge networks perspective.

From Knowledge Management to Knowledge Networks

Knowledge management is a critical concern for contemporary organizations, and it is expected to become increasingly important in the future (Nonaka and Takeuchi, 1995). It has long been recognized that computers could increase the range, depth and speed with which information could be acquired, processed, presented for use and shared for collaborative efforts. However, research in this area has given little attention to theoretical or conceptual issues about information acquisition, processing and integration, and even less attention to theoretical issues about the antecedents and consequences of different patterns of information distribution within work groups, and the conditions under which information can be and is easily shared among group members. Recent developments in technologies have shown their potential as knowledge management systems, although little is known about the social challenges and motivations for group members to use these systems effectively. These challenges call for a knowledge network approach (Monge and Contractor, 2001) and knowledge-based theories to understand groups' use of new media

Groups as Knowledge Networks

The proliferation of digital technologies has dramatically changed the nature of work in groups. These technologies, as described previously, have the potential to provide many benefits to groups by linking people who have common goals and interests but are separated in time and space. They may enable organizations to develop effective teams from workers who are geographically distributed.

Today, in stark contrast to just a decade ago, virtual teams consider having employees located in time zones far removed from one another (such as California, Ireland and India) as a competitive advantage rather than a disadvantage. Members of distributed work teams can work round the clock in order to meet the competitive demands of a global marketplace. In some cases the members of these teams are 'e-lancers' (electronic freelancers) who coalesce on a short-term project and then disperse. In other cases, the technologies have the potential to enable the organization to hire and retain the best people, regardless of location (Townsend et al., 1996). These changes have led scholars to call for a reconceptualization of groups as much more fluid, dynamic, multiplex and activity based (Goodman and Wilson, 2000).

Clearly these new technologies have the potential to nurture a team by linking the members not only to one another but also to a large number of internal and external knowledge repositories. Conceptually, therefore, it is increasingly useful to consider the group and its members as a network of agents, where some of the agents are human agents while others are non-human agents (such as knowledge repositories. avatars and webbots). Human agents communicate with one another by retrieving and allocating information relevant to their collective tasks. An increasingly vexing question that group members face in this networked environment is not which medium to use (as was addressed by earlier theories of media choice), but rather which agent to use.

Groups and the media they use can be usefully reconceptualized as a *knowledge network.* A network is made up of a set of nodes and relations between these nodes. The nodes that contain the knowledge can be people. databases, computer files or other forms of repositories. The relations are the communication relations (that is, publishing, retrieving, allocating) among the nodes. The location of knowledge within this network of agents can vary along a continuum from centralized. where knowledge resides with only one agent, to distributed, where knowledge exists among many agents (Farace et al.. 1977). Distributed knowledge may refer to the parts of a larger knowledge base, each possessed by separate actors within the network. In this form of distributed knowledge, actors bring relatively unique. non-redundant knowledge which enables a collective to accomplish complex tasks. Distributed knowledge occurs at many levels in the empirical world, including work groups, large-scale project teams, and interorganizational strategic alliances. Alternatively, distributed knowledge may refer to the flow or diffusion of knowledge, which increases the level of knowledge among all actors.

Communication networks, actual knowledge networks, and cognitive knowledge networks are different ways of conceptualizing the network of agents. Communication networks represent the degree to which individual agents interact with other agents in the network. Actual knowledge networks represent the actual distribution of knowledge among the network of agents. Cognitive knowledge networks represent individuals' perceptions of the distribution of knowledge in the network of agents. Knowledge networks are dynamic, in terms of both agents and linkages. Agents join or leave a knowledge network on the basis of tasks to be accomplished, and their levels of interests, resources and commitments. The links within the knowledge network are also likely to change on the basis of evolving tasks, the distribution of knowledge within the network, or changes in the agents' cognitive knowledge networks. New media, such as intranets, serve both as the infrastructure that sup ports the development of relations in the network and as the nodes in the network. In our own research, we have applied a knowledge network perspective to theories that investigate new media use in groups and organizations (Hollingshead etal., 2001; Monge and Contractor, 2001).

We believe there is tremendous potential for the development and extension of theories which seek to explain the development of a group's use of media as a knowledge network of human and non-human agents. The knowledge network perspective is especially well suited to test multiple theories and their contradictory or complementary influences on the evolution of the groups. Knowledge networks and their defining characteristics can be represented and analysed exceptionally well using techniques developed within the field of social network analysis (Wasserman and Faust, 1994). These techniques enable researchers to examine the dynamics of relations at multiple sites and across different levels of analysis (individual, dyads. group, organizations and industries). It is difficult to predict the types of configurations that groups with technology will take in the future. Regardless of their forms, a knowledge network perspective will allow future researchers to examine, describe and evaluate new media and organizing at the group level.

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