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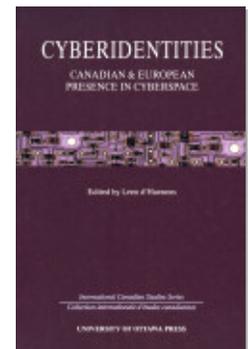
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# WORK AND COMMUNITY IN NETWORKED ORGANIZATIONS

by Caroline HAYTHORNTHWAITE

## I COMPUTER-MEDIATED COMMUNICATION IN ORGANIZATIONS

The many new types of computer-mediated communication (CMC) technologies provide co-workers with an increasing number of ways to exchange information. The traditional face-to-face meeting and office memo are now supplemented by electronic mail (email), listservers, bulletin boards, the Web, the telephone, voice-mail, videoconferencing and group decision support systems. As organizations make greater use of CMC, there has been a corresponding interest in understanding how the use of computer media fits with and serves the work of the group, team, or organization. Organizational and institutional decision makers want to know how computer media can aid the information exchange process, what types of information are best delivered through which media, and why people choose to use one medium over another.

Research on CMC and other forms of “groupware” is often technology-driven, focusing “on solving the technical problems of providing multiple-user facilities for any application program.” (Bannon & Schmidt, 1991: 7) Studies are directed at improving features of the medium, such as screen displays and functional capabilities. Studies of the use of such technologies have also tended to take a technological approach, focusing on the attributes of computer media, such as what visual, auditory or vocal cues can be transmitted. The lack of cues has been associated with a lack of “social presence” (Short, Williams & Christie, 1976) or a lack of “richness” in the capacity of the medium (Daft & Lengel, 1986). Analysts suggest that rich media (e.g., face-to-face contact), that convey the full array of verbal and non-verbal cues, are best suited for messages, including rich information, e.g., communications that involve negotiation or consensus building, or which include intellectually difficult or socially sensitive content (Fish, Kraut, Root & Rice, 1992; Sproull & Kiesler, 1991; Daft, Lengel & Trevino, 1987).

In contrast, studies from a Computer-Supported Cooperative Work (CSCW) or “social informatics”<sup>1</sup> perspective consider social and organizational aspects of media use. CSCW studies strive to understand the work and information exchange needs of an organization and to adapt the technology to the organization or vice versa (Bannon & Schmidt, 1991). The social informatics perspective expands the social aspects of information technologies to include “the roles of information technology in social and organizational change and the ways that the social organization of information technologies are influenced by social forces and social practices.” (*Social Informatics* home page)

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<sup>1</sup> See the *social informatics* home page at <http://www-slis.lib.indiana.edu/SI/>

See also the forthcoming issue of *Journal of the American Society for Information Science* (JASIS); details on this issue are available at <http://www.asis.org/Publications/JASIS/socialinformatics.html>

Studies on computer technology that take a CSCW or social informatics perspective include examination of: the ways in which the adoption of information technologies either change social structures in organizations (e.g., Burkhardt & Brass, 1990), or compete with the existing organizational structures (Markus 1983; Noble & Newman, 1993); how organizational mandate can affect media use (e.g., Markus, 1994); and how social interaction defines and redefines the meaning and appropriate use of media (e.g., Contractor & Eisenberg, 1990; Markus, 1990; Rice, Grant, Schmitz & Torobin, 1990; see also the collected papers in Fulk & Steinfield, 1990). These studies show that the use of computer technologies (including CMC) affects and is affected by the norms and social structures of the environment in which the technology is situated.

Moreover, the use of CMC is not an individual decision. Its usefulness and manifestation in any environment depends on complex interactions between who is talking to whom and about what, the array of available media, the group norms associated with media use, and the norms associated with communicating with different types of people. When a computer network links people as well as machines, it creates and sustains a social network (Wellman, 1997; Wellman et al., 1996). It supports strong, intermediate and weak ties between people – allowing friends to exchange social support, arrange meetings and coordinate activities, and allowing those who have never met to exchange support about a specific problem in on-line chat rooms, or to find technical know-how among members of an organization (Constant, Kiesler & Sproull, 1996; Feldman, 1987). Such networks can support specialized relationships, such as those based on single interests such as a particular type of car, health issue, or hobby (e.g., Baym, 1997; Mickelson, 1997). They can also support more broadly-based relationships such as those between work friends whose collaboration on projects also includes a measure of “socializing.”

For the past seven years, members of our Virtually Social Research Group have been studying *computer-supported social networks* (Wellman, Salaff, Dimitrova, Garton, Gulia & Haythornthwaite, 1996). Research by members of the group includes studies of: the *role of CMC* in social networks within organizations (Garton, 1995; Garton & Wellman, 1995; Haythornthwaite, 1996a; Haythornthwaite, Wellman & Mantei, 1995; Haythornthwaite & Wellman, in press); *telework* (Dimitrova & Salaff, in press; Salaff, Dimitrova & Hardwick, 1996); and the *invisible colleges* of scholars (see Table 1). In keeping with CSCW and social informatics researchers, the context in which computer networks are placed is considered an important factor in the ways that computer networks support social relations. Thus, rather than conducting laboratory studies, research by our group members includes fieldwork, in-depth interviews, and social network surveys studying communication in actual organizations.

The principles and techniques of *social network analysis* guide the studies of computer-mediated communication conducted by this group. Social network analysis is the study of social structure and its effects. Analysts focus on *patterns of relations between actors* and examine the availability of resources and the exchange of resources between these actors (Haythornthwaite, 1996b; Monge & Contractor, in press; Wasserman & Faust,

1994; Wellman & Berkowitz, 1988). This focus on patterns of relationships, such as who works with whom, or who exchanges information with whom, distinguishes social network analysis from other analysis techniques. Regular patterns of relations reveal themselves as *social networks*, with actors as *nodes* in the network and relations between actors as *connectors* between nodes. When visualized in graphic form, network structures can be compared to physical networks such as roads: just as roads structure the flow of resources between cities and towns, relationships structure the flow of resources among major and minor actors in a social environment.

The resources that are exchanged can be of many types, including tangibles such as goods or services, and intangibles such as information, social support or influence. Each particular type of resource exchange represents one social network relation. Network relations can be differentiated by their content (work directions, socializing), direction (from a supervisor to a supervisee), and strength (how often are work directions given, how much of a resource is exchanged). Thus, researchers ask questions such as, "How often do you give advice to... [each member of their group]?" The patterns of relations between actors revealed by such questions indicate the likelihood that individuals will be exposed to particular kinds of information. Patterns of forwarding and receipt describe networks that show how resources move around an environment, and how actors are positioned to facilitate or control the resource flow.

The social network approach, with its identification of relations and ties, provides a useful means of viewing Internet and intranet relationships. In a CMC context, the types of resources that can be exchanged are those communicated to others via text (e.g., via email), visual images, and/or audio (e.g., video-mail, voice-mail). For example, actors can share information (news or data), discuss work, give emotional support, or provide companionship via CMC. In organizations, CMC networks can be internally-oriented, supporting intra-organizational activities via organizational intranets, proprietary email networks, and bulletin boards. They can be externally-oriented, facilitating cooperation across organizations or groups. CMC networks also support individuals outside the organizational context, as seen by the vast array of Usenet interest groups. Organizational networks may support multi-stranded ties when co-workers mix work and social exchanges (McGrath, 1984, 1991; Haythornthwaite, Wellman & Mantel, 1995; Wellman, Carrington & Hall, 1988), and they can support single-stranded ties when co-workers solicit help across the internal network (Constant, Kiesler & Sproull, 1996; Feldman, 1987). Extra-organizational networks also support multi-stranded relationships, for example, when family members communicate via CMC. They also allow individuals to maintain single-stranded ties, for example, when individuals join an interest group that focuses on one topic. (For further details on using a social network approach for the study of CMC, see Garton, Haythornthwaite & Wellman, 1997.)

In the research conducted by our group, we use a social network approach to address such questions as: Are the norms and practices of computer-supported social networks different from face-to-face networks? How do gender, organizational position, friendship, work relations, and geographical proximity affect the use of different media

for different sorts of interaction? Are computer-mediated ties more stable or unstable than those developed by more traditional means? Do computer-supported social networks flatten differences in status or physical proximity?

Across the studies, we find that intranets and the Internet are simultaneously making interactions more global and more local. More global, in that interactions can, and do, routinely flourish over great distances. More local, because online interactions come from deskbound people who may be less apt to engage with the worksite or community around them (Wellman, Garton, & Haythornthwaite, 1997). We also find that CMC is simultaneously making interactions more multi-stranded and more specialized. More multi-stranded, as friends who work together mix work and friendship via computer networks, and as families add CMC to other, more traditional means of communicating; more specialized, as ties are maintained based on a single shared interest among people who will probably never meet.

## II A SOCIAL NETWORK STUDY OF A COMPUTER-SUPPORTED SOCIAL NETWORK

The remainder of this paper describes, in brief, a study of the computer-supported social networks of members of an academic group.<sup>2</sup> The group, which will be referred to by the pseudonym *Cerise*, consisted of faculty, students, and employees in a computer science department of a major Canadian university. These individuals maintained work and community ties through a variety of media, including the telephone, email, fax, and a desktop videoconferencing system that was under development at the time of the study. As well, they had ample opportunities for unscheduled face-to-face encounters, in the hallway or cafeteria, and they met regularly face-to-face in scheduled classes and research meetings. The *Cerise* culture encouraged work sharing and communication in a supportive, collaborative environment. Work was important in *Cerise*, and included the production of computer programs and papers for course work, presentation, and publication.

The rapid growth of email and other forms of CMC has led to questions about the circumstances under which people use these media to support their work and community relations. R&D environments, such as that of *Cerise*, have been of particular interest to CSCW researchers because of the non-standard interactions that support collaboration (see for example, Fish, Kraut, Root & Rice, 1993). Media use debates have been largely dominated by (1) discussions of how a particular medium fits specific kinds of information exchange tasks, such as collaborative work tasks; and (2) discussions of how group norms determine the appropriateness, and the use, of different media in different settings. A social network approach was taken in initiating this research, asking not just what information fits what media, nor just what group

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<sup>2</sup> Detailed descriptions of this research can be found in Haythornthwaite, Wellman & Mantei, 1995; Haythornthwaite 1996a; Haythornthwaite & Wellman, in press.

norms prevailed, but asking as well, “How do relationships such as work and friendship ties affect who communicates with whom and via what media?”

The first step in this research was to address information exchange and to determine what kinds of information exchange were of importance to the group. Group members were asked to complete a questionnaire asking about a wide variety of work and social activities that required group members to communicate. The questionnaire gathered data not only on what types of information group members exchanged, but also on who they exchanged that information with, via which media. Table 1 provides an example of the question format.

**Table 1:** Example of the questionnaire format

TYPE OF INTERACTION	<i>Cerise</i>	1	2	3	...	20
Members:						
How often have you received instructions (i.e., exact directions on what work to do) from this person?						
in unscheduled face-to-face meetings						
in scheduled face-to-face meetings						
by telephone						
by fax						
by electronic mail						
by videoconferencing						

How often: D for daily W for Weekly M for Monthly Y for Yearly 0 for never  
 For in between amounts use e.g., 2D for twice a day, 6Y for six times a year.

Respondents were asked to identify the 20 *Cerise* members with whom they communicated most frequently, and to answer each question in relation to each of these 20 correspondents. For each question, respondents recorded “how often” they communicated with each of their 20 correspondents via each of six media. The total *Cerise* population included 35 co-located members, of whom 25 completed the questionnaire (19 of 26 students, 2 of 4 faculty, and 4 of 5 employees). Although respondents were asked to report on 20 correspondents, they actually reported on their communications with from 10 to 20 correspondents, giving a total of 378 respondent-correspondent pairs who communicated at least once a year.

In order to evaluate how work and friendship ties affect communication and media use, respondents were asked to indicate their working and their friendship relations with others in *Cerise*. Reported working relations could be formal, informal or non-working; friendship relations could be *close friend, friend, acquaintance, or work with only*.<sup>3</sup> These reports showed that the majority of ties in *Cerise* were working ties, either informal or formal, combined with friendly relations. The array of work and friendship ties provided a picture of the “typical” *Cerise* member’s communication

<sup>3</sup> There was also a “heard of only” category, but none of these individuals were listed as one of the 20 correspondents.

circle. This egocentric network consists of 15 members of *Cerise* with whom the typical member communicated at least once a year: they were formally tied with 3 others, informally tied with 10, and had a non-working tie with 2 members of their networks. These same 15 also included 2 close friends, 7 friends, 4 acquaintances, and 2 with whom they worked only.

## 2.1 Defining the types of information exchange

The questionnaire included 24 questions that asked “how often” pairs interacted on different types of activities. Factor analysis revealed six dimensions from these 24 activities (for details, see Haythornthwaite, Wellman & Mantei, 1995), which were named: Receiving Work, Giving Work, Collaborative Writing, Major Emotional Support, Sociability, and Computer Programming (see Figure 1).

These dimensions revealed the following important considerations about information exchange in *Cerise*:

- The separation and importance of Receiving Work and Giving Work highlighted direction of communication as a key distinction in *Cerise* communication patterns.
- Major work tasks and the two major work products of *Cerise* distinguished different communication patterns, i.e., Receiving Work, Giving Work, Collaborative Writing, Computer Programming.
- Information exchange dimensions were distinguished by whether or not they included emotional content: with Sociability, Major Emotional Support, and Receiving Work including affective relations.

Examination of media use at this stage showed that that the use of unscheduled and scheduled face-to-face meetings, and email predominated in *Cerise*. These means of communication fit with the group norms of the group. These *Cerise* members shared office space in the same building, and thus met face-to-face in unscheduled ways. They also participated in group activities and found themselves together in scheduled meetings both for work (e.g., research meetings) and for socializing (e.g., departmental parties). As well, email accounts were provided to all members of *Cerise* and its use was promoted and encouraged by faculty and students.

## 2.2 Assessing information exchange and media use in *Cerise*

In the second part of the research, the six information exchange dimensions were treated as six social network relations. To provide frequency of communication estimates for each of these relations, the number of communications for each pair for all of the specific activities making up the relation were aggregated. (For example, the frequency of communication for Collaborative Writing was calculated by summing the communications of the pair for written work and for exchanging documents, see Figure 1; to normalize frequency distributions, they were logged.)

These data were examined in several ways relating to social network measures:

- The strength and range of each relation was assessed by examining (1) the frequency of communication between pairs, and (2) the number of pairs communicating regarding each relation. This was examined for overall communication and for communication via each medium.
- The multiplexity of relations was assessed by examining the number of information exchange relations maintained by pairs, showing how single- or multi-stranded ties operated in *Cerise*.
- The multiplexity of media use was assessed by examining the number of media used by pairs, showing how single- or multi-stranded the use of media was in *Cerise*.
- The number and types of information-media combinations maintained by pairs were examined to determine whether each medium was equally capable of supporting each type of information exchange.

These matters were examined first for all pairs, and then by status, reported work tie, and reported friendship tie.

#### *Information exchange*

These examinations revealed that the “typical *Cerise* pair” maintained three of the six information exchange relations. Consideration of both the number of pairs maintaining each of the six information exchange relations and the frequency of communication shows that, most commonly, these three relationships were: Sociability, plus the two relationships associated with work allocation, Giving Work and Receiving Work (see Figure 1). These three relations were the heart of the routine day-to-day operations of this research group, comprising the majority of information exchanges. Not only were people giving instructions on what to do or discussing what they had been doing, they were also providing the sociable companionship that supports work relationships.

Looking more closely at communication by pairs shows that those pairs who maintained few relationships (one or two) typically maintained a low frequency Sociability link, i.e., they maintained a weak tie. When two relations were maintained, pairs included a low frequency Receiving Work relation or a Computer Programming relation that was characterized mainly by attendance at demos, both of which are essentially passive relations. Pairs who maintained 3-4 relations show the profile of the “typical pair” with more frequent Sociability, and with the respondent reporting a more collaborative tie with their correspondent that included both Receiving Work and Giving Work. Pairs who maintained nearly all relations (five or six) included relations that involved mutual trust and knowledge, i.e., Collaborative Writing and Major Emotional Support. As pairs maintained more relations, they also communicated more frequently. Thus, *Cerise* social networks are characterized on the one hand by wide-ranging but low frequency connections based on Sociability, and on the other hand by high frequency communication about many different work and social activities among a smaller number of pairs.

*Media use*

The typical *Cerise* pair used just over two media to communicate, chosen from unscheduled meetings, scheduled meetings or email. But, the choice of media was not random; the media used by pairs conforms to a unidimensional Guttman scale (Guttman coefficient of reproducibility = 0.92) in this order: unscheduled meetings, scheduled meetings, email, and then the “other” media (telephone, fax, videoconference). In *Cerise*, email was not a “poor cousin” as a communication medium: email was used to maintain both sociable and instrumental relations, and was the main choice for communication after face-to-face meetings. This is due in part to the varied time schedules of *Cerise* members. It is also due to the strong culture of email use in *Cerise*.

In the same manner as for information exchange, a high frequency of communication was significantly correlated with use of more media. Thus, a high frequency of contact was associated with both (1) the exchange of many types of information; and (2) the use of many media. Thus, pairs weakly tied in terms of the range of information they exchange are also weakly tied in the channels they use to exchange that information. Pairs with strong ties show frequent, multi-stranded information exchange and multi-channel information exchange.

*Information-media combinations*

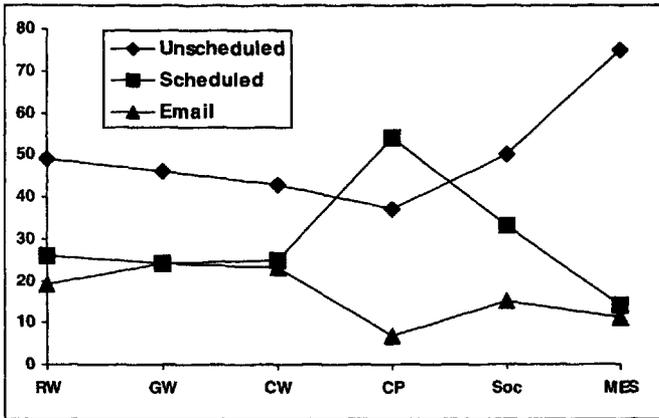
Examining what media pairs used to exchange what types of information provides an opportunity to address one of the major questions in the media debate, i.e., do pairs choose to use one medium over another for different kinds of information exchange? Results from *Cerise* show that, overall, media use differed more in number than in type, with high frequency communicators using more media to communicate about each of the different types of information they exchanged. However, some differences were noticeable across the different relations.

Media use for the work-oriented relations, Receiving Work, Giving Work, Collaborative Writing, and Computer Programming, was characterized by control: more communications between more pairs were accomplished via scheduled meetings and email than via other means (see Figure 1, parts A and B). Note that these are also the media associated with group norms: i.e., scheduled meetings such as classes and research meetings, and the culturally promoted email. Less frequent but more wide-ranging unscheduled meetings also supported these relations.

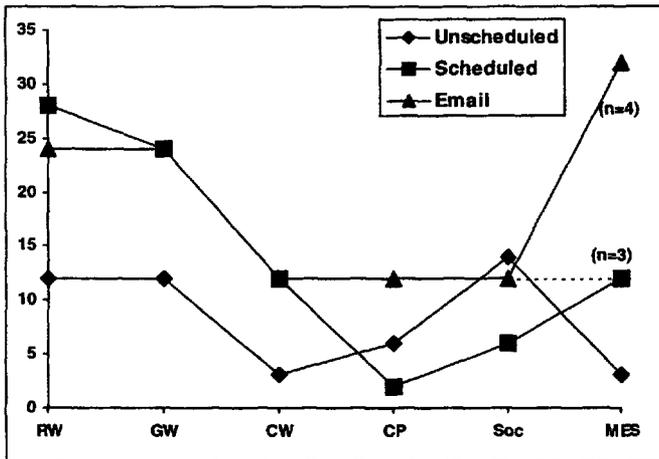
For the socially-oriented dimensions, Sociability and Major Emotional Support, media use was characterized by spontaneity, with unscheduled meetings predominating. The media use also appeared to follow the interaction pattern of the pair: e.g., unscheduled meetings for close friends; unscheduled and scheduled meetings and email for work-only pairs. Messages appear to “piggy-back” on media used to carry work relations, particularly for pairs who interact primarily for work (e.g., work-only pairs and formally tied work pairs; see Haythornthwaite, 1996).

**Figure 1: Information-media combinations**

**A. Percentage of pairs by relationship and medium**



**B. Median frequency of communication by relationship and medium**



RW: Receiving Work; GW: Giving Work; CW: Collaborative Writing; CP: Computer Programming; Soc: Sociability; MES: Major Emotional Support  
 Note: Frequency of communication for MES via email is largely attributable to one pair; without this pair the median frequency of communication is 12.

*Interpersonal ties, information exchange and media use*

Each of the communication patterns described above were associated with frequency of communication: i.e., the more frequent the communication, the more relations maintained, and the more media used. Who were the frequent communicators in *Cerise*? Pairs in a formal work tie, a close friendship tie, and pairs that included a faculty member as either a respondent or correspondent communicated more

frequently than other pairs and continue the pattern found overall. These pairs maintained more relations than other pairs, used more of all available media to communicate, and used more of all available media to communicate about each relation they maintained.

The type of tie is also associated with an increased frequency of communication and number of media used for types of information that are important for the tie. Pairs in a formal work tie show increased frequency of communication for the work-oriented relations Receiving Work, Giving Work, Collaborative Writing, and Computer Programming. Pairs that included a faculty member show increased frequency of communication for the work allocation relations Receiving Work and Giving Work. Pairs in a close friendship show increased frequency of communication for all the work and social relations and were the most frequent communicators overall (Haythornthwaite, 1996a; Haythornthwaite & Wellman, in press).

### III CONCLUSIONS

This research shows how the social network approach allowed assessment of the types of information exchange and media that were important to the group as a whole, and important to particular pairs. By examining communication from one member to another, without labelling the pairs a priori as belonging to a particular class (e.g., by status), we find communication patterns that describe group interactions and describe subsets of group interactants, e.g., frequent communicators, close friends, and formal work pairs.

In *Cerise*, the type of tie (formal work tie, close friendship, etc.) appears to set the number and types of information the pair exchanges, e.g., formally tied work pairs exchanging work information, and close friends exchanging both work and social information. By following the interactions of pairs, rather than summarizing information exchange and media use across the whole of *Cerise*, we see that the more multi-stranded the information exchanges by pairs, the more multi-stranded their media connections. Thus we can say that strong social network ties are based on high frequency exchange of many different types of information, but also the use of many types of media.

We also find that the types of media used depend on frequency of communication, with the types of media added to a pair's repertoire following a predictable unidimensional scale: from unscheduled face-to-face meeting, to scheduled face-to-face meeting, to email, and then to other means of communication. Both the pair tie and the group norms set this order. Weakly tied pairs communicate infrequently and use few media, staying with face-to-face means of communication. Strongly tied pairs communicate frequently and use many media, adopting first the email, so strongly supported in *Cerise*, and spreading from there to the other media. Thus, group norms may be said to set the order of media used, and within that order, pairs set the number of media they need to use. Instead of finding support for message-medium fit, we find

that media use expands to fit the media available, with that expansion progressing in accordance with local norms for media use and with the social network ties maintained by pairs, creating the overall computer-supported social network.

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