Netting Scholars

Online and Offline

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Has the Internet affected the ways in which people communicate by lessening the effects of distance? To examine this question, the authors study scholarly and interpersonal relationships—in person and by e-mail—in two scholarly networks, one in a large university and one dispersed across North America. These scholarly networks are harbingers of the turn toward network and virtual organizations. Although the Internet helps scholars to maintain ties over great distances, physical proximity still matters. Those scholars who see each other often or work near each other e-mail each other more often. Frequent contact on the Internet is a complement to frequent face-to-face contact, not a substitute for it. The more scholarly relations network members have, the more frequently they communicate and the more media they use to communicate. Although e-mail helps scholars without strong ties to stay in contact, it is used most by scholars who are collaborators or friends.

The Internet's ability to span continents at a single bound has reduced the constraints of time and distance. Global communication is as easy, rapid, flexible, and low cost as chats between neighbors. Except for a few antediluvians and those economically below the digital divide, people in industrialized countries are becoming wired, as are substantial segments of population in developing countries (Hargittai, 1999). But, does practice follow possibility? We examine the situation through the study of scholarly networks, academics who, with the

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Internet at their disposal, have the means and the desire to communicate online as well as offline.

The Internet should profoundly affect scholarly relations because the scholarly life is rarely silent, lonely, or contemplative. Effective scholars do not talk only to themselves. They lecture to undergraduates, mentor graduate students, present papers, knife each other in committees, schmooze at conferences, gossip over lattes, send off grant proposals, and even write articles and books. Scholars have a message to get out to the world, or at least to their corner of it. They cannot leave their work moldering in their desk drawer or on their hard drive if they want to advance scholarship, influence public opinion, advise policy makers, find kindred souls, or promote their careers. Many scholars work together, be they physicists sharing megamillion-dollar equipment, computer scientists engaged in collective enterprises, or lonely scholars trading ideas. Through their networks, scholars seek advice, information, help, approval, employment, fame, and fortune.

Scholarly communication has been mostly face to face ever since Eve told Adam about the New Age properties of apples. Babylonian King Nebuchadnezzar summoned his "magicians, enchanters, sorcerers and astrologers" to intepret his dreams[1] (Daniel 2), Socrates strolled the agora with his disciples, Plato fantasized camping in caves with contemplative compatriots, and Samuel Johnson expounded in 18th-century coffee houses. Italian Renaissance scholars held meetings for discussion intended to advance the development of literature, science, philosophy, and technology (Marshall, 1970). Scholarly networks became formalized at the start of the Enlightenment, with the founding of the Royal Society of London in 1660 to 1662, soon followed by similar societies throughout Europe and America (Price, 1961). These early scholarly networks spanned many disciplines, witness the French Encyclopedists' attempt to codify all knowledge in the 18th century (Diderot et al., 1772/1965). Intermittent correspondence and journeys kept scholars in different cities and countries in haphazard contact.

The 19th century's increase in the scale of scholarship and the Industrial Revolution's turn toward hierarchical bureaucratic organizations made broadly based scholarly societies less central. The main bases for scholarly organization became spatial proximity or disciplinary affinity. Most scholars work in physically compact universities (or similar research centers), where they meet students and colleagues face-to-face (FTF). Yet, universities and their departments are polyglot, physically compact bureaucracies geared for organizing teaching and administering physical resources. Their organization into discipline-based departments was a 19th-century Industrial Revolution imposition of formal boundaries between broad areas. Yet, a department's faculty is intentionally diverse to serve students and the public in a smorgasbord of areas. This diversity promotes lectures and discussion that provoke lateral thinking. Yet, it also means that university departments often are too diverse to be suitable venues for scholars wanting to discuss specific problem areas.

The 20th century's proliferation of research, researchers, and research publications has meant a global increase in the number of specialists in each area. Increased specialization means that the scholars most interested in each other's work usually live elsewhere because few universities care to employ two experts on the same subject. Intellectually kindred souls find each other by forming professional associations within their discipline or interdisciplinary interest area. Such associations are rarely local. Scholars must go to (often great) lengths to communicate with distant kindred souls. They spend time and money junketing to conferences. They read periodicals. Or they use the post to circulate preliminary thoughts and findings, then wait impatiently for replies. They avoid telephoning, because it is intrusive, rarely finds the other party in, and is not suited to conveying figures, equations, or precise text. They eschew expensive faxes and courier services.

As a set of scholars gets used to seeing each other at conferences and in journals and develops the habit of discussing each other's work and perhaps collaborating, all or part of their network becomes crystallized as a less amorphous invisible college, defined by a shared interest in a speciality and by friendship ties. Such invisible colleges "function as a scholarly in-group within a given specialization," their research "facilitated by informal exchange of information through contacts within this social network at conferences and other forums" (Gresham, 1994, p. 38). Their structures are networks with crosscutting ties between sets of scholars on both the core and the periphery. The informal nature of these invisible colleges affords flexible, adaptive structures for exchanging and evaluating new ideas. Their lack of formal structure means that communication depends on the structure, frequency, and quality of scholarly ties.[2]

Invisible colleges provide forums for sharing, disseminating, and testing new ideas, as well as for exchanging information about research, funding opportunities, academic bureaucracies, and personal situations. They promote scholarly identity and purpose and stimulate discussion of theory, methods, and findings. Ideas get transmitted more quickly and innovatively than in formal journals constrained by publication lags and orthodoxy-promoting refereeing.

THE ETHERIZATION OF SCHOLARLY NETWORKS

Before the Internet, travel costs and limited communication channels meant that scholars communicated more with colleagues in other fields at their own universities than they did with specialists in their own fields at other universities (Carley & Wendt, 1991; Friedkin, 1982). At the turn of the millennium, the Internet's characteristics affect—but do not determine—how scholars communicate. We focus here on e-mail (electronic mail), the computer-mediated communication on which the scholars we study rely. E-mail is usually asynchronous, allowing scholars in different time zones or on different schedules to

communicate. One study found that computer scientists working in nearby offices used e-mail to compensate for different work schedules (Haythornthwaite & Wellman, 1998). Although instantaneous "chat groups" are becoming popular among the public for recreational use, we do not expect them to become prevalent in scholarly networks except when a few people are collaborating full-time in a focused crash project. Most scholars, like most professional and managerial workers, do not welcome the unlimited communication access that chat brings. They want to retain their communication autonomy and control to switch between multiple projects and tasks (Wellman, 1997).

E-mail is rapid, fostering a high velocity of exchanges, sometimes ill-considered (Walther, Anderson, & Park, 1994). It supports nuanced and complex interactions, belying early fears that it would be useful only for simple, instrumental exchanges. It has its own norms, procedures, and ethos. People discussing issues and solving problems online show greater creativity and emotional swings than do those talking FTF (Sproull & Kiesler, 1991). The absence of direct feedback in e-mail encourages more extreme forms of communication. Scholars type messages onto screens that they would never say to a palpably present person or on the telephone. This leads to scholarly upsets, feuds, and cleavages. The ability of communications to be forwarded supports transitive indirect ties that aid flows of information across group boundaries. This integrates scholarly "networks of networks" (Craven & Wellman, 1973) instead of isolating information in tightly bound groups.

E-mail supports easy accessibility, leading to a leveling of perceived hierarchies, with all believing they have access to all. The ease of sending messages to large numbers allows scholars to remain in direct communication with many others, without mediation by a core person or oligarchy. The ease of sending messages to focused lists of others allows scholars to be members, perhaps unobtrusively, of multiple groups. They do not have to commit to one or a few groups. This enables them to be brokers and bridges, transmitting information from one group to another (Burt, 1992). E-mail is especially useful for maintaining contact with weak ties: scholars and scholarly networks with whom one does not have close relationships of information exchange, collaboration, or friendship. As weak ties are more heterogeneous than strong ties, they connect scholars to diverse intellectual and social milieus by providing a wider range of information. E-mail's accessibility, ubiquity, velocity, and multiple-message char- acteristics potentially can connect the entire scholarly world in five steps or less (White, 1970). In practice, there is significant decoupling so that information diffuses rapidly but neither universally nor uniformly (Valente, 1995; Wellman & Berkowitz, 1988).

The rapid growth in use of e-mail has led to questions about the circumstances under which people use such media. FTF conversations and e-mail exchanges have different capacities to convey social cues, contextual meaning, detailed information, and nonverbal communication. Complex, ambiguous, socially sensitive, or intellectually difficult materials may need the immediate

feedback and interactivity of FTF communication, whereas e-mail may be appropriate for the frequent transmission of research information.[3] Yet, communication is not solely a product of the medium used. It is also a social phenomenon, in which the nature of the relationship, the social network, and the social position of participants influence what is communicated and what media are used to communicate it. If almost everyone is using e-mail, then the recalcitrants will use e-mail or be left out of the loop.

E-mail has allowed spatially dispersed, intellectually kindred scholars to communicate and collaborate with an ease formerly found only within university departments and research centers. Computer networks have become social networks as scholars exchange information, collaborate, administer, and socialize. They use e-mail for rapid exchanges, one-to-one or to small groups; they post announcements, queries, debates, and jokes on group discussion lists (sometimes called *list-serves*); they circulate findings and ideas in ethereal papers circulated as attachments to e-mail; they use the Web to access data sets and research tools. "The keyboard is my café," MIT's dean of architecture and planning enthuses (Mitchell, 1995), replacing agoras, coffee houses, and faculty clubs. Yet, although e-mail is widely used, some fundamental questions remain to be answered, including:

- Has the map of the world dissolved so much that distance does not matter in globalized networks?
- Has the Internet replaced or supplemented the post, the telephone, and FTF contact?
- Can strong ties be sustained online?
- Has the Internet brought spatial and social peripheries closer to the center?
- Does computer-mediated communication facilitate working in networks rather than groups?
- Are scholarly networks harbingers of new forms of loosely coupled organizations?

SCHOLARLY NETWORKS AS VISIBLE COLLEGES

To address these questions, we analyze relationships and media use in two scholarly networks. Although our evidence is limited to these two networks, the information they provide is germane because such scholarly networks are exemplars of the loosely coupled organizations currently proliferating online and offline.

Technet and Globenet (pseudonyms) are more visible than many scholarly networks because they are beneficiaries of the 1990s' fashion for governments, corporations, and universities to encourage invisible colleges. Each has been formally founded (developing out of informal scholarly networks) and has a public name, a budget, a director, and some staff time. Each has an identity that is

visible both to members and to outside observers. Naming, funding, and administering have crystallized these networks as visible colleges with more formal channels of communication and defined membership than invisible colleges. At the cost of flexibility, their greater formality provides more stability, institutionalized bases for collaboration, and more opportunities to receive financial support.

Technet connects scholars in a large Canadian university who share interests in linking the social sciences with technology. We interviewed its 24 active members, 16 men and 8 women, coming from many departments and research institutes and ranging in age from the late 20s to the late 70s. Graduate students also participate actively. Many members feel that they more often find kindred souls in Technet than in their own departments. Membership is voluntary and open to all university members. Technet members receive no financial support. There are frequent activities: seminars, conferences, committee meetings, proposal writing, retreats, and parties. Some members are working together, submitting joint project proposals, both under the auspices of Technet and through other university institutions.

Unlike Technet, Globenet is not associated with one university. It is one of eight multidisciplinary programs within a larger, continent-spanning research institute. Globenet emerged in the early 1990s, the intellectual outgrowth of informal discussions in two programs at the larger research institute. Much of the research activity is in Canada, although dispersed in five widely separated provinces. Five members work in the United States, and 1 works in Europe. Only 10 (4%) of the pairs[4] of members work in the same city, 6 in the same department. We interviewed all 16 of its members: 13 men and 3 women, ranging in age from mid-40s to mid-60s. Unlike Technet, Globenet has government and corporate support to reduce the time its members spend teaching and increase the time available for research, collaboration, and networking. To join the network, a scholar must be deemed to be doing important research and have a personality that complements existing members' work. Nine senior fellows receive full salaries from the program, whereas seven associates receive partial funding. Globenet members usually work autonomously from one another but are expected to make available to each other their expertise, resources, and research findings. In addition to common funding and commitment to Globenet's scholarly approach, members have worked together to produce a book integrating its first 5 years of analysis and findings into a single, coherent account. Globenet funds all members to attend three FTF conferences per year, each lasting 4 days. A shared vision, the availability of financial support, a formal selection process, defined boundaries, and mandatory group meetings have made this scholarly network a visible college.

Data collection. Interviews in the summer and fall of 1997 elicited both qualitative and quantitative information about scholarly and friendship relations inside and outside Technet and Globenet. During the interviews, each scholar

was given a roster of all of the members of the network and asked to describe his or her scholarly and interpersonal relations with each member and with other scholars who were not members of Technet or Globenet. This method elicited reports about each pair's scholarly work relationship, social closeness, frequency of scholarly and nonscholarly communication, and communication media used.[5] We obtained usable information about 405 ties within Technet and 240 ties within Globenet, our effective sample sizes. As most interviews were lengthy and conducted at the members' research offices, we were able to observe the members' styles of work and communication. Koku attended gatherings and committee meetings of Technet, and Nazer attended Globenet meetings (see also Nazer, 2001).

SCHOLARLY RELATIONSHIPS IN THE WIRED WORLD

MODE AND FREQUENCY OF COMMUNICATION

Even in these wired times, members of both local Technet and far-flung Globenet rely on FTF contact as their primary means of communication, supplemented by other forms of traditional and computer-mediated technologies. At least half of the contacts between members of each network are FTF. The statistics in Table 1 underestimate the significance of FTF contact, as FTF contact is usually of longer duration and provides more communication bandwidth.

Technet and Globenet have different communication styles. All Technet members work at one university campus and are easily able to meet FTF for scheduled and unscheduled interactions. Therefore, it is not surprising that FTF interactions connect more Technet members than any other medium: 78% of all pairs have some FTF contact. They are in frequent contact: 90% of all pairs communicate with one another at a mean of 20 times per year and a median of 10 times per year. As all Technet members are comfortable with computers, they use e-mail often: 56% of all Technet pairs have some e-mail contact.

E-mail supplements rather than supplants FTF contact, with members using it to arrange FTF meetings, disseminate news, and exchange documents. Those Technet members using e-mail send messages to each other at a mean rate of 24 times per year, an average of twice per month. To Technet members, non-FTF communication means computer-mediated communication. Only a minority use telephones, faxes, and couriers, and those who do use these media use them infrequently. The most widely used of these are local telephone calls, used by only 25% of the members. Those who telephone do so on the average of once per month (mean = 11 calls per year).

By contrast, Globenet members principally communicate at their formal FTF group meetings. Although Globenet's dispersed network makes it harder for its members to be in FTF contact, mandatory attendance at its meetings means that

TABLE 1: Media Use in Two Scholarly Networks

	Technet (n = *405*)			*Globenet* (n = *240*)		
		Mean Annual Frequency of Use			*Mean Annual Frequency of Use*	
Medium	*Percentage of All Pairs Using Medium*	*All Pairs*	*All Pairs Using Medium*	*Percentage of All Pairs Using Medium*	*All Pairs*	*All Pairs Using Medium*
Face-to-Face	78	16	19	100	4	4
E-mail	56	13	24	32	2	5
Phone	25	3	11	21	1	5
Post/courier	0.2	0	1	21	0.7	3
Fax	0	0	0	15	0.7	5

all pairs have at least some FTF contact. Half (52%) of the Globenet pairs only communicate at these meetings, whereas another 25% also have FTF contact outside of these meetings. Although all members communicate FTF (unlike Technet), most do so rarely. They communicate FTF an average of only 4 times per year, probably at the three meetings plus one other time (see Table 1). However, those Globenet pairs who do keep in touch outside of the group meetings do so almost as frequently as Technet members, at a mean rate of 15 times per year and a median rate of 10 times per year. Several Globenet members are less comfortable with e-mail than are the more computerized members of Technet. E-mail is used by a lower percentage of Globenet pairs (32%), compared with Technet pairs, and those Globenet pairs who do use it send only an average of five messages per year.

Media multiplexity. Analysts have wondered whether computer-mediated communication replaces or complements FTF, phone, and postal means of communication (Carley & Wendt, 1991; Haythornthwaite, 2000; Haythornthwaite & Wellman, 1998). Both Technet and Globenet show complementarity: The frequency of e-mail contact is positively associated with the frequency of FTF and phone contact in both networks, as is the frequency of postal mailings and faxes in Globenet (Table 2).[6] People who are in much contact use all modes of communication: Whatever is necessary or is handy.

Most Technet pairs and some Globenet pairs use a combination of communication media to keep connected. Technet pairs use more kinds of media than Globenet pairs use: 32% use two media, and 23% use three or more. On the other hand, the loosely structured, voluntary nature of Technet means that 12% of the pairs never communicate. By contrast, all Globenet pairs communicate. However, more than half (56%) use only one means of communication, FTF interaction at Globenet meetings, whereas 18% use two media. Yet, the 26% of

TABLE 2: Correlation of Frequency of Contact by Medium, Technet/Globenet

	Phone	*E-mail*	*Fax*[a]	*Post*
Face-to-face	0.31*/0.37*	0.52*/0.40*	NA/0.35*	–0.00/0.27*
Phone		0.61*/0.27*	NA/0.43*	0.60/0.48*
E-mail			NA/0.17*	0.00/0.37*
Fax				NA/0.45*

NOTE: NA = not available.
a. No Technet member uses fax.
*$p < .01$.

Globenet pairs using three or more media is similar to Technet, suggesting that those with intense work involvements use multiple means to communicate.

Location. When Globenet pairs work in the same city, they see each other FTF more often (mean = 18 times per year). Those working in different cities see each other 3 times per year at the Globenet meetings. Although e-mail should not be constrained by distance, Globenet pairs working in the same city communicate by e-mail more often (an average of 12 times per year) than pairs working in different cities (an average of only once per year). In part, this is because those working in the same city (and often in the same university and department) have relations with each other in addition to their scholarly Globenet relations. In part, the exchange of e-mail among members bolsters the FTF contact of those who work near each other. Yet, most pairs based in different cities rely only on their FTF interactions at Globenet meetings. For example, Andrew Oldfield (a pseudonym) "prefer[s] interacting with members at meetings and discussing research when I see them. I really don't have much contact with them otherwise."

Scholarly and interpersonal relationships. The more focused nature of the Globenet network is apparent, in that 22% of its scholarly pairs have collaborated, compared with 17% of the Technet pairs (Table 3). Moreover, 64% of the Globenet pairs have discussed each other's research, and 60% have read each other's work. Technet is more loosely connected: Although 72% have discussed each other's research, this has been casual. Only 17% have actually read each other's work.

Most Technet and Globenet pairs have good collegial or friendship relationships: 18% of Technet members report friendship ties with other members, 41% report collegial ties (strong, but without friendship), 30% are acquaintances, and 12% have no relationship (Table 3). Globenet pairs tend to have somewhat stronger ties, despite their less frequent communication. One quarter (25%) of the pairs are friends, and 49% are colleagues; only 21% are acquaintances, and 5% have no relationship at all. Thus, 59% of Technet pairs are friends or colleagues, as compared with fully 74% of Globenet pairs.

TABLE 3: Scholarly and Interpersonal Relationships (in percentages)

Relationship	*Technet* (n = *405)*	*Globenet* (n = *240)*
Scholarly relationship		
Collaborate	17	22
Discuss research	72	64
Read each other's work	17	62
Interpersonal relationship		
Friend	18	25
Colleague	40	49
Acquaintance	30	21
No interpersonal relation	12	5
Scholarly multiplexity		
No scholarly relation	10	20
One relation	43	28
Two relations	42	36
Three relations	5	16

In both Technet and Globenet, friends are more likely to communicate by multiple media than are colleagues. Whereas friends use 2.4 media to communicate in Technet and 2.8 in Globenet, Technet acquaintances use 1.5 media and Globenet acquaintances use only 1 medium of communication: FTF contact at Globenet meetings.

Scholarly multiplexity. About half the pairs in Technet (47%) and Globenet (52%) have more than one scholarly relationship: collaborating, discussing ideas, or reading each other's work (see Table 3). Most pairs in both networks have one or two scholarly relationships: a mean of 1.4 for Technet and 1.5 for Globenet. Technet and Globenet pairs who maintain more scholarly relations with each other are in more frequent contact, thereby solidifying their relations. Technet fosters this type of relationship by providing the venue and context for exchanging ideas and forming collaborative ties. A Technet pair's number of scholarly relations is significantly correlated, at 0.38, with the frequency of their FTF contact and, at 0.28, with the frequency of their e-mail contact. Similarly, a Globenet pair's number of scholarly relations is significantly correlated, at 0.42, with the frequency of their FTF contact and, at 0.40, with the frequency of their e-mail contact. Globenet ties who maintain more than one type of scholarly relationship are also more likely to have a higher frequency of communication. However, almost all (96%) of those Globenet pairs who do not have any scholarly relationships do not communicate, except for casual chats at meetings. By contrast, half of those Globenet pairs who maintain all three scholarly relationships are in contact at least once per month.

Those members of both Technet and Globenet who also are friends are more apt to engage in more kinds of scholarly relations: collaborating, discussing research, and reading each other's work (Table 4). The most pronounced effects of the strength of interpersonal relations on scholarly relations are at the extremes. Friends have a mean of 2.2 scholarly relations in Globenet and 1.7 in Technet. By contrast, those who have no interpersonal relations hardly ever have any scholarly relations.

Otherwise, the two networks have different patterns of scholarly and interpersonal relations. Those in Technet who are acquaintances or colleagues have about as many scholarly relations as do friendship pairs in Technet. In Globenet, stronger interpersonal relationships have more scholarly relationships. Reflecting the greater mutual focus of the Globenet core, 80% of Globenet friendship pairs engage in two or more scholarly relations, as compared with 62% of Technet colleagues. Three times as many of Globenet pairs (15%) compared with Technet pairs (5%) engage in all three types of relationships: collaborating, discussing research, and reading each other's work. The largest difference is between weak acquaintanceship ties (0.5 scholarly relationships) and stronger ties of colleagueship (1.7).

Strong scholarly and friendship relations develop in positive feedback duets. Friends collaborate and discuss each other's work; collaborating scholars develop stronger friendship ties. One observer of this dialectic, cosmologist James Hartle (University of California, Santa Barbara) says of his collaboration with Nobel prize-winner Stephen Hawking (Cambridge University): "Generally, 'it's the science that drives it' while friendship naturally follows" (quoted in Glanz, 1999, p. D2). In Globenet, Calvin Scott and David Green had no prior relationship, even though they were both working in the same large university. They met at an early meeting and soon decided to teach an interdisciplinary course jointly. Another member, Jason Smith, "barely knew most of the members, but now I have made several new friends. It has been great for restructuring my personal life."

Interpersonal relations and media use. Technet and Globenet pairs with stronger interpersonal relationships use more types of media to communicate. Friends use more types of media than colleagues who, in turn, use more types than acquaintances (see Table 4).

The two networks have different patterns of media use. Almost all Technet pairs with strong friendship ties (92%) use at least two media to communicate, as do 65% of collegial pairs (Table 5). They typically use FTF, e-mail, and perhaps phone or printed paper. By contrast, many Globenet pairs only communicate FTF, and most use fewer types of media than Technet pairs. Whereas 87% of Globenet friends use two or more media, only 43% of collegial pairs do so. Moreover, acquaintances communicate FTF only at Globenet meetings. On the other hand, a much higher percentage of friends in Globenet use four or five media to communicate: 33% as compared with 1% in Technet. This is because

TABLE 4: Mean Number of Scholarly and Media Relationships by Interpersonal Relationship

	Technet			*Globenet*		
	Mean Number of Relationships			*Mean Number of Relationships*		
Interpersonal Relationship	*Scholarly Multiplexity*	*Media Multiplexity*	n	*Scholarly Multiplexity*	*Media Multiplexity*	n
Friend	1.7	2.4	47	2.2	2.8	61
Colleague	1.5	1.9	123	1.7	1.8	117
Acquaintance	1.6	1.5	160	0.5	1.0	50
No relation	0.06	0.0	75	0.08	1.0	12
	$F = 102.5$*	F = 193.4*	405	$F = 65.5$*	$F = 32.1$*	240

*$p < .05$.

TABLE 5: Number of Media Used by Interpersonal Relationship

	Number of Media Used (%)						*Total*	
Interpersonal Relationship	*0*	*1*	*2*	*3*	*4*	*5*	*%*	n
Technet								
Friend	0	8	39	52	1	0	100	75
Colleague	0	34	39	26	0	0	100	160
Acquaintance	2	59	29	10	0	0	100	123
No relation	100	0	0	0	0	0	100	47
Total	12	33	32	23	0.2	0	100	
n	49	134	128	93	1	0		405
Globenet								
Friend	0	13	27	27	25	8	100	61
Colleague	0	57	20	13	3	7	100	117
Acquaintance	0	94	4	2	0	0	100	50
No relation	0	100	0	0	0	0	100	12
Total	0	56	18	13	8	5	100	
n	0	134	43	32	18	13		240

NOTE: χ^2 test omitted because of abundant cells with zeros.

Technet pairs use the Internet rather than faxes or the post to exchange documents.

The more types of scholarly relationships network members have, the more types of media they use to communicate. The significant correlations are 0.44 for Technet and 0.53 for Globenet. The higher correlation coefficient for Globenet suggests that the greater distance between its members leads them to use a variety of media to communicate. In short, the strength of interpersonal

relationships, the number of scholarly relationships engaged in, and the number of media used are all positively associated in both networks.

Scholarly relations, interpersonal relations, and media use. All predictors analyzed account for a substantial amount of the variance in FTF contact: 42% for Technet and 31% for Globenet. Similarly, they account for a substantial amount of the variance in e-mail contact: 39% in Technet and 36% in Globenet.

Neither Technet nor Globenet scholars are all work and no play. Perhaps more accurately, their play is intertwined with their work, and for these high achievers, their play is often their work. Whatever the dynamics, friendship is the single strongest predictor of both FTF and e-mail contact in both Technet and Globenet (Table 6).

In Technet, friendship is the strongest predictor of the frequency of FTF contact. Although collaboration is strongly related to the frequency of FTF contact, it is unrelated to the frequency of e-mail contact. As scholars are on the same campus, collaborators can easily walk to each other's offices and use more bandwidth to communicate.[7] This is congruent with the theories of media use suggesting that tasks requiring complex negotiations are better conducted via richer media such as FTF contact. Technet members use FTF contact when possible, using e-mail to fill in temporal and informational gaps. Those Technet members who often read each other's work communicate more frequently by e-mail. Where FTF contact is easily done, it is the preferred medium for collaborative work. Yet, colleagues can now easily share their ideas and their work—or announce its existence—by e-mail and Web postings. They do not have to walk to each other's offices to do this; Canadian winters can inhibit in-person visits (see Michelson, 1971).

Not only are collaborative and friendship ties associated with high levels of FTF interaction, FTF contacts can develop collaborative and friendship relations. For example, Sharon Julia discovered at Technet seminars that she shared research interests with Danny Perot and Jessica Fleet. She believes that this may lead to collaboration.

The situation is different in Globenet. The distance between a pair's universities, collaboration, and friendship are statistically significant predictors of the frequency of FTF and e-mail contact. In addition, reading each other's work is also significant for the frequency of e-mail contact (see also Haythornthwaite, 2000; Haythornthwaite & Wellman, 1998). Globenet members use both FTF and e-mail to get their joint projects done. The dispersion of Globenet members across North America (and England) leads them to use e-mail as a collaborative tool more than Technet members. However, Table 6's negative coefficients for distance suggest that the geographically closer two members of scholarly pairs are, the more they will communicate.[8] This is not surprising for FTF contact, but it is for e-mail, in which a pair working far apart should be able to communicate as easily as those e-mailing in the same building.

TABLE 6: Regression of Scholarly and Interpersonal Relationships on Frequency of Media Use

	Technet (n = *405)*				*Globenet* (n = *240)*			
	Face-to-Face		*E-mail*		*Face-to-Face*		*E-mail*	
Predictors		p *Value*		p *Value*		p *Value*		p *Value*
Collaborate	0.50*	0.00	0.08	0.65	0.19*	0.00	0.22*	0.00
Discuss research	0.38	0.06	–0.04	0.83	0.06	0.37	0.03	0.60
Read each other's work	0.05	0.15	0.08*	0.04	0.17*	0.00	0.06	0.35
Friend	0.51*	0.00	0.70*	0.00	0.30*	0.02	0.41*	0.00
Colleague	0.38	0.09	0.42	0.07	0.26	0.07	0.09	0.50
Acquaintance	0.36	0.10	0.21	0.34	0.13	0.23	–0.01	0.95
Distance[a]	NA		NA		–0.32*	0.00	–0.15*	0.00
Adjusted R^2	0.42		0.39		0.31		0.36	

NOTE: NA = not applicable.
a. Distance and the frequency of face-to-face and e-mail contact logged to the base 10.

CENTRALIZATION

As e-mail makes it easy for any network member to communicate directly with any other, e-mail networks should be less centralized than FTF networks (Rice, 1994; Wellman, 1997). We analyze the extent to which the two networks are centralized or decentralized.

The most central actor (highest *indegree*[9]) in both the Technet FTF and e-mail networks is the founder and then-director of Technet. Other central members of the FTF and e-mail networks are members of the executive committee, who represent important disciplinary clusters. Different disciplines at the university are connected to each other indirectly by means of the many ties that Technet's executive committee members have with one another. In Globenet as in Technet, the director has the highest indegree in the e-mail network, almost twice as high as anyone else. The assistant director and the coeditor of the central Globenet book have the second highest number of members contacting them by e-mail. However, the coeditor as well as the director have higher indegrees in the FTF network because they both deal heavily with all the members contributing to the Globenet book. Both also work in universities where one or two other Globenet members also work, providing more opportunity for FTF contact.

Variation in individual centrality scores describes how centralized is a network's connectivity. This is true for Technet, where the e-mail network is less centralized (centralization score = .34) than the FTF network (score = .56). Most Technet members send and receive e-mails, but FTF contact between them is more variable. By contrast, Globenet's centralization is lower for FTF contact (score = .32) than for e-mail contact (score = .61). This is because all Globenet members gather for meetings, where having FTF contact with each other is easy. E-mail contact is more focused in Globenet, with many more messages going to

and from the network's leaders. This leads to a high centralization score. That Globenet's FTF network is less centralized than its e-mail network shows that the effects of communication media can only be understood in the context of the networks' social structures and environing contexts.

TOWARD A GEOGRAPHY AND SOCIOLOGY OF THE WIRED WORLD

HAS THE MAP OF THE WORLD DISSOLVED SO MUCH THAT DISTANCE DOES NOT MATTER IN GLOBALIZED NETWORKS?

Distance still matters, because scholars continue to chat FTF when convenient. There is "glocalization" (Hampton & Wellman, 1999; Wellman, 2001), with e-mail expanding local interactions and global reach. These scholars use e-mail as much to arrange and follow up on local FTF meetings as they do to keep in long-range e-mail contact. Globenet relies more on FTF communication than Technet, even though it is more geographically dispersed. Network communication and solidarity are accomplished by supporting the travel of all members to three Globenet FTF meetings per year.

Although some Globenet members rely heavily on e-mail for long-distance collaborations, this is the exception and not the rule. The globe-spanning potentiality of e-mail reduces the constraints of distance on contact but does not eliminate them. In practice, distance continues to matter for e-mail contact, as those who work nearer to each other use e-mail more often to communicate. E-mail is not the basis for a separate system of relationships but operates jointly with FTF contact. The nearer pairs are, the more they get together, and the more they use e-mail to arrange get-togethers and to follow up on FTF discussions.

HAS THE INTERNET REPLACED OR SUPPLEMENTED THE POST, THE TELEPHONE, AND FTF CONTACT?

E-mail is used by network members near and far to speed their scholarly exchanges. It has added to the amount of communication between scholars rather than shifting communication away from FTF contact. This conclusion is suggested by the positive correlation of e-mail with all other means of communication: FTF (the principal means used), telephone, fax, and the post. FTF and computer-mediated communication, the two dominant modes, reinforce each other. This helps explain why our group has found that local e-mail predominates among Globenet members working in the same university and among highly wired computer and information science students at the University of California, Berkeley (Wellman, 1999).

The impact of e-mail is not so much in what is communicated but in who communicates with whom, how frequently, and over what distances. E-mail is a complement to in-person, FTF communication and not an alternative. It fills the gaps between FTF meetings, allowing more communication among scholars far away and even those nearby. This increase in the velocity of communication—its speed and frequency—can affect the quality as well as the quantity of the information exchanged, as new techniques and findings get disseminated and false trails become abandoned more quickly. We suspect that the social impact of e-mail and other forms of computer-mediated communication will be similar to the impact of the telephone. Its more important effects will not be in the novelty of the means of communication but in the subtle ways in which it facilitates changes in the fabric of relationships, networks, and societies.

CAN STRONG TIES BE SUSTAINED ONLINE?

The stronger the tie, in friendship and in scholarship, the more online (and FTF) contact there is. It is not as if FTF or e-mail contact is found only among certain types of ties: All of the ties in Technet and Globenet connect by e-mail as well as FTF. These networked scholars use e-mail for a wide range of things: exchanging drafts among coauthors, setting up meetings, asking for information, or gossiping about colleagues. Although pundits worried a decade ago about whether merely textual e-mail could sustain a wide range of interactions—from information seeking to emotional stroking—it is the social context more than the nature of the medium that affects whether e-mail will be used. Expectations only a decade ago that e-mail would be used for purely instrumental communication appear to have been a product of early fascination with the novelty of e-mail and an overemphasis on Marshall McLuhan's (1964) speculation that the medium is the message. For example, Globenet members are required to attend three FTF meetings annually. As most work separately the rest of the year, e-mail is used only among those who are strongly tied through friendship or collaboration. By contrast, Technet members routinely use e-mail among themselves—it is part of their interest in computer-mediated communication— and the strongly tied pairs are most apt to have voluntary FTF get-togethers.

The nature of the tie predicts media use more than does the nature of the communication task. Strongly tied collaborators and friends use whatever communication means are necessary to interact, exchange information, and coordinate. The more types of relationships they have, the more frequently they use both FTF and e-mail. Even when working nearby, they often find e-mail communication handier for spontaneous communication than walking a few hundred meters to talk FTF. These ties are strong enough that they can be maintained extensively through the narrower bandwidth of e-mail and refreshed through occasional FTF meetings.

HAS THE INTERNET BROUGHT SPATIAL AND SOCIAL PERIPHERIES CLOSER TO THE CENTER?

The Internet's speed and ubiquity have led the cofounder of the Electronic Frontier Foundation to hail it as "the most transforming technological event since the capture of fire" (Barlow, Birkets, Kelly, & Slouka, 1995, p. 36). The ability of all to communicate rapidly with all, no matter where located, has created hopes that peripheries would become as well-connected as centers. As distance essentially does not matter for computer-mediated communication, spatial isolation should not be a problem. As all are connected to all, heretofore disconnected people, groups, and branch plants should be equally as able as those at the center to communicate with others. This should affect the structure of scholarly networks: As e-mail helps maintain direct ties, social density increases and the periphery—whether spatial, social, or scholarly—can become better connected with the core (Garton & Wellman, 1995).

Although some studies have shown that peripheries are more active online than FTF, these studies have used laboratory experiments to compare groups communicating only FTF with groups communicating only by e-mail (Wellman et al., 1996). Yet, people in the real world use both FTF and e-mail to communicate, and the social situations that they are in are more important than the communication media they use in affecting how centralized they are. For example, whereas Technet's members have less centralized communication by e-mail, for Globenet members, FTF communication is less centralized. Globenet's annual meetings create the opportunity, the reason, and the expectation that all will speak with all. These conditions are not found in Globenet's more sporadic e-mail exchanges. In short, e-mail creates opportunities for all to communicate, but it does not necessarily create reasons to communicate or force people to communicate. In many situations, FTF can create more favorable situations for widespread communication, with e-mail lurking unnoticed. Ubiquitous connectivity does not mean universal communication. As cyber euphoria fades, software agents will provide background detail about computer-mediated communicators and prioritize callers (Wellman, 2001). They will reenact a situation at least as old as Shakespeare's *King Henry IV,* Part I, where Glendower brags, "I can call spirits from the vasty deep." To which Hotspur replies, "Why, so can I, or so can any man; But will they come when you do call for them?" (III, 1).

DOES COMPUTER-MEDIATED COMMUNICATION FACILITATE WORKING IN NETWORKS RATHER THAN IN GROUPS?

We are living in a paradigm shift in the way in which people and institutions are becoming more connected through social networks and less so through groups. Members of old-paradigm societies deal only with fellow members of the few groups to which they belong: at home, in the neighborhood, at work, or in voluntary organizations. They belong to a discrete work group in a single

organization; they live in a household in a neighborhood; they belong to one or two kinship groups and to discrete voluntary organizations: churches, bowling leagues, professional associations, and the like. All of these are hierarchically structured bodies with precise boundaries for inclusion.

By contrast, in new-paradigm networked societies, boundaries are more permeable, interactions are with diverse others, linkages switch between multiple networks, and hierarchies are flatter and more recursive (Castells, 1996; Wellman, 1988, 1997). Although computer networks have not caused this paradigm shift, they have aided it. E-mail and the Web let people move between their different social networks and interests. Hierarchical barriers are lower online and much less apparent. Although Globenet has strict inclusion criteria, both Globenet and Technet claim only a portion of their members' time, energy, allegiance, and contacts. It is easy for their members to maintain an e-mail address book with thousands of names and to maintain multiple lists of like-minded scholars whom they can contact at the drop of an e-mail alias. E-mail gives them ease and flexibility in who communicates with whom, what means they use to communicate, what they communicate, and when they communicate (Wellman, 2001).

ARE SCHOLARLY NETWORKS HARBINGERS OF NEW FORMS OF LOOSELY COUPLED ORGANIZATIONS?

Although scholarly networks have been with us for half a millennium, they have moved online. The Internet is providing a technological basis for new forms of spatially dispersed, loosely bounded networks of scholars who are more connected than the fitful, amorphous anarchies of the past and less physically proximate and bureaucratically structured than contemporary universities. The velocity of communication is more rapid, distant scholars stay in touch more, and e-mail and attachments fill gaps between FTF meetings. This greater connectivity does not happen automatically. Those who avoid the medium, as do some Globenet members, do not get the message. But the Internet is available, used often, and used for all kinds of communication by many of the scholars we studied.

Who cares about scholars anyway, in these days of stock market fever, economistic hegemony, anti-intellectualism, and targeted applied research? In addition to our interest in our own tribe, scholarly networks are harbingers of the turn away from tightly bounded, highly structured bureaucracies to social networks with amorphous boundaries and shifting sets of work relationships, inside and outside of organizations. Scholarly networks are windows into a widespread phenomenon: the development of organizations as networks and virtual organizations (see also Nardi, Whittaker, & Schwartz, 2000). The change from groups to networks can be seen at multiple scales. Trading and political blocs have lost their monolithic character in the world system; organizations form complex

networks of alliance and exchange; workers (especially professionals, technical workers, and managers) report to multiple peers and superiors.

In contrast to the situation in traditional organizational structures, employees in network organizations have multiple, shifting work partners and partial involvements with shifting sets of work groups (Powell, 1990; Wellman, 1997). Work relations are dispersed, with ties often extending across cities, provinces, nations, and even continents. Structurally, these ties extend to multiple units within the organization and, at times, to organizations elsewhere. Like scholars in a university, employees of network organizations often have a good deal of discretion about with whom they deal, how they are going to interact, and the time and place of their interactions (Salaff, Wellman, & Dimitrova, 1998). As organizations become more globalized, such flexibility is necessary and is best afforded by computer-mediated communication.

Technet, operating within one university, is a network organization. Its members are constantly juggling commitments to it and attempting to convince their supervisors and colleagues of its legitimacy and usefulness. On the go, shifting collegial ties by the day and the hour, Technet's members make use of whatever means of communication are at hand to connect with each other. As they are physically dispersed on campus, this communication often takes the form of e-mail. FTF contacts would involve long walks; telephone calls are intrusive and have a low probability of finding the peripatetic Technet members in their offices.

Unlike network organizations that operate within a single organizational structure, virtual organizations are temporary task networks whose participants are members of multiple organizations. These networks extend between organizations as they develop partnerships that mesh expertise, locale, and access to resources to pursue "specific opportunities, or mutually beneficial relationships in the market" (Roberts & Grabowski, 1996, p. 418). The participants in virtual organizations are supposed to work as a team, even though they are paid by, and subject to the discipline of, their separate organizations. Typically, this is a team with partial commitment, as the participants do not give their full time or dedication to the virtual organization. They have other projects and task groups in which they are involved (Ahuja & Carley, 1998).

Globenet, operating between universities and across the continent (and the Atlantic Ocean), is a virtual organization whose boundaries are more social than geographical. Although its members are seconded to Globenet, their careers are also built around their university homes. Interaction patterns reveal the members' multiple commitments. When they are at Globenet meetings, members participate eagerly and actively. Yet, most rarely communicate between these meetings unless they are collaborating on a research project or are at the same university. To be sure, a fair portion of their time is spent working on Globenet-relevant activities, but the inexorable pressures of the physically proximate university structure and their university colleagues compete actively with their more ethereal scholarly relationships in Globenet. Computer-mediated

communication can help deal with differences in distance and time zones; it cannot wipe away the lure of the proximate and the press of the university's social and power structures.

Despite these caveats, network and virtual organizations proliferate as they provide organizations with internal flexibility and better ability to form coalitions. These new organizational forms are responses to changes in globalized postindustrial economies that have created unstable environments in which bureaucratic organizations are less effective. They operate in a business environment that often requires organizations to be distributed, decentralized, team based, and rapidly reactive to threats and opportunities (Castells, 1996; DeSanctis & Jackson, 1994; Miles & Snow, 1986; Nohria & Eccles, 1992; Powell, 1990). Just as Globenet and Technet have shifting scholarly alliances and information exchanges, the flexibility of networks and virtual organizations allows them to respond more effectively than hierarchies to changing conditions. This comes at the cost of divided loyalties and weakened control. No one unit controls the participants' behavior, and participants do not have a single situation to which they belong and with which they identify.

The ability of computer networks to connect people beyond immediate organizational and community groups can provide an enhanced basis for the organic solidarity of cross-cutting ties that early sociologist Émile Durkheim (1893) saw as the key to social cohesion. This will not be globalization in the sense of each individual and organization maneuvering alone in social and cyberspace. The globe will continue to be structured but more by multiple, integrative links among social networks than by a series of bounded groups. There will be a continuing dialectic between local and global allegiances and interactions. Relationships will be based more on shared interests than on shared territory or office space. This wired, networked world should be a more multifaceted, albeit uncertain, place than the world of palpable, solitary groups.

NOTES

1. Unlike pundits today, their failure meant their death.

2. See the discussions in Breiger, 1976; Crane, 1969, 1972; Crawford, 1970; Cronin, 1982; Finholt, 1998; Finholt & Olson, 1997; Gaston, 1973; Gresham, 1994; Griffith & Mullins, 1972; Hill & Carley, in press; Price & Beaver, 1966; Walsh & Bayama, 1996; Wellman, 2000.

3. Fish, Kraut, Root, & Rice, 1993; Haythornthwaite, 2000; Haythornthwaite & Wellman, 1998; Kiesler & Sproull, 1992; Rice, 1987; Trevino, Lengel, & Daft, 1990.

4. Two people who have a tie (which means they have one or more relations). The definition is directional: an A $\Rightarrow$ B tie is treated separately from a B $\Rightarrow$ A tie.

5. The specific questions asked were about collaborating, discussing research ideas, reading each other's publications, friendship/colleagueship/acquaintanceship relations, frequency of communication, and types of media used.

6. Frequency of contact logged to the base 10. There is a greater substantive impact of communicating twice per year instead of once than there is of communicating 365 days per year instead of 364 days.

7. The authors of this article similarly found they needed to be working face-to-face to handle complex queries about data analysis.

8. Distance is logged to the base 10 because the consequences of being 20 miles apart rather than 10 are much greater than the consequences for being 1,020 miles apart rather than 1,010.

9. *Indegree* counts the number of people who send messages to each network member (Wasserman & Faust, 1994). It is an indicator of a scholar's position and activity in a network. An indegree centralization score is a measure of the range of network members' choices of other network members, comparing each member's indegree score to the maximum attained value. It reaches a maximum of 100% when one network member chooses all other members and the other members choose only this one central member (Wasserman & Faust, 1994, p. 180).

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