An Electronic Group is Virtually a Social Network

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BIOGRAPHY

Barry Wellman learned how to keypunch at Harvard University, where he received his Ph.D. in 1969. He's now Professor of Sociology at the University of Toronto, based at the Centre for Urban and Community Studies. Wellman founded the International Network for Social Network Analysis in 1976 and served as its Coordinator for twelve years. His research investigates social networks of work and community, off- and online.

Computer Networks as Social Networks

When a computer network connects people, it is a social network. Just as a computer network is a set of machines connected by a set of cables, a social network is a set of people (or organizations or other social entities) connected by a set of socially-meaningful relationships. My aim here is to show how social network analysis might be useful for understanding how people relate to each other through computer mediated communication (see also Wellman & Gulia, 1996; Wellman, et al., 1996).

Social network analysis conceives of social structure as the patterned organization of these network members and their relationships. Social network analysts work at describing underlying patterns of social structure, explaining the impact of such social structures on other variables, and accounting for change in social structures. Social network analysis has developed procedures for detecting structural patterns, seeing how patterns of different types of relationships interrelate, analyzing the implications that structural patterns for the behavior of network members, and studying the impact on social structures of the characteristics of network members and their social relationships. In the past three decades, social network analysis has produced a range of concepts, findings and methods in the social sciences (Berkowitz, 1982; Wellman 1988b; Scott, 1991; Wasserman & Faust, 1993). For example, analysts have demonstrated the role of social networks in providing interpersonal support (Wellman, 1992), structuring riots and other political contentions (Tilly, 1984), channeling the flow and settlement of immigrants (Salaff, Fong & Wong, 1996), linking seemingly disparate personnel at work, and connecting ostensibly independent organizations (Nohria & Eccles, 1992).

The social network approach provides ways for analysts to think about social relationships that are neither groups nor isolated duets. Instead of an either/or distinction between group membership and social isolation, researchers can bring to bear in their analysis a set of structural variables, such as the density and clustering of a network, how tightly it is bounded, and whether it is diversified or constricted in its size and heterogeneity, how narrowly specialized or broadly multiplex are its relationships, and how indirect connections and positions in social networks affect behavior. For example, the fact that Person A and Person B interact online may have to be interpreted in the light of the offline reporting relationship of Person B to Person C, the company president. Thus thinking about relationships in social networks rather than in groups can allow analysts to take into account the contexts within which relationships operate.

Although all studies have to start somewhere with some populations, many network analyses do not treat formal group boundaries as truly social boundaries, be they departments in organizations or officially-designated neighborhoods in cities. Instead they trace the social relationships of those they are studying, wherever these relationships go and whomever they are with. Only then do network analysts look to see if such relationships actually cross formal group boundaries. In this way, formal boundaries become important analytic variables rather than *a priori* analytic constraints.

The distinction between groups and social networks opens up consideration of how the characteristics of computer supported social networks affect the behavior of the people using them and the social systems in which these networks are embedded.[1] Just as a local area network is only one kind of a computer network, a group is only one kind of a social network. More precisely, a group is a social network whose ties are tightly-bounded within a delimited set and are densely-knit so that almost all network members are directly linked with each other. To be sure, there are densely-knit and tightly-bounded work groups and community groups. Yet there are other kinds of work and

community networks whose relationships are sparsely-knit with only a minority of members of the workplace or community directly connected with each other. These relationships tend to ramify out in many directions like an expanding spider's web rather than curling back on themselves into a densely-knit tangle.

For example, a bunch of people who hang out together -- at work, in a café or on an internet discussion group -- can studied as either a group or a social network. Those who study them as groups assume that they know the membership and boundaries of the groups. They might ask how important each group is to its members, how the groups are governed and make decisions, and how the groups control members. Yet in all but laboratory situations researchers will be faced with the real-world problem that members are entering and leaving a group over time. By contrast, those who study such entities as social networks can treat their membership and boundaries as open questions. For example, frequent participation in an internet discussion group might be treated as the basis for membership but so might be the indirect connections (and resource flows) that discussion group members provide to others outside the group. The patterns of relationships becomes a research question rather than a given.

By definition, people who use computer networks have social relationships with each other that are embedded in social networks. Yet much of the analysis of online relationships via the study of "computer-mediated communication" has focused on two-person dyads rather than on the broader social networks in which these dyads are connected. People's relationships with other strongly affect their social resources, mobility, happiness, work habits and many other important things about them. Hence it makes sense to use social network analysis to understand the patterns of relationships that people have online in addition to fine-grained analyses of online dyads.[2]

To collect information about computer social networks, analysts must first decide whether they are doing *whole network* or *ego-centered* network analyses. The more common whole network analyses gather information about relevant relationships within some population, where both the relevance of the relationship and the population are defined by the investigator. For example, our research group is studying relationships online and offline among a set of university computer scientists (Haythornthwaite, Wellman & Mantei 1995; Haythornthwaite & Wellman, 1996b) and a small organization (Garton, 1995). We collected information before and after the adoption of videoconferencing. At each wave, we asked all the members of the organization to report on how frequently they were interacting at that time with every other network member. We asked about such interactions for a score of different relationships, such as "supervising work" or "socializing after work." We asked separately about the frequency of interaction via with each network member in each kind of relationship (supervising, etc.) for a number of different modes of communication used by these participants: email, videoconferencing, informal unscheduled in-person encounters, and formally scheduled in-person meetings.[3] We are now using a variety of network analytic techniques, coupled with field notes from ethnographic observation and in-depth interviews, to analyze these data.[4]

We shall also study the ego-centered (or personal) networks of each participant: a set of ties defined from the standpoint of the person at its center. Rather than showing the whole network from the God-like standpoint of an external observer, ego-centered analyses are Ptolemaic views of networks as experienced by each individual (Wellman, 1993). Typically, network analysts use standard survey techniques to ask a sample of respondents to describe each member of their

networks: the members' social characteristics (such as age and gender), the characteristics of the relationship between each member and the respondent (e.g., kin or friend, frequency of contact, kinds of support provided), and (less reliably) the characteristics of the relationship (if any) between two members of each respondent's network.

In thinking about how to use the social network approach to study patterns of interaction online, two linked questions are relevant for this chapter:

- (a) How do different social network patterns of relationships affect interactions, online and offline.
- (b) How do computer mediated communication affects patterns of social relationships.

My objectives are to discuss how computer networks support a variety of social networks at work and in the community. I consider first the implications for computer supported social networks of two opposing ideal types: dense, bounded groups and sparse, unbounded networks. Then, I show how some of the key concepts of social network analysis apply to understanding relationships on-line. To conclude, I work from a social network approach to suggest research questions for future studies of computer mediated communication and computer supported social networks.

Groups and Networks of Community and Work

Social scientists and the public alike have tended to see dense, bounded groups as the desirable form of community and work while fearing that technological change, industrialization and urbanization have so isolated people to create alienated individuals, standing alone in mass societies (e.g., Nisbet, 1962). Such fears continue to be expressed as analysts try to anticipate the social consequences of widespread involvement in computer mediated communication (e.g., Stoll, 1995). Yet a good deal of research has demonstrated that in contemporary society, both dense, bounded groups and sparse, unbounded networks exist simultaneously at work and in communities. Indeed, the same persons may be involved in both, as they iterate between different workgroups and communities, or as the workgroups and communities themselves change in response to external situations and internal dynamics. Nevertheless, there are systematic ways in which involvement in dense, bounded groups of work and community are different from involvement in sparse, unbounded networks in which the active players shift frequently.

Dense, Bounded Groups

Work: Conceptualizations of how work is organized have developed since the preindustrial, Adam Smith-ian image of small groups of densely-knit workers. With the coming of the Industrial Revolution, this image gave way to a notion of large masses of workers organized in compartmentalized bureaucratic structures whose reporting relationships resembled tree-like hierarchies. Yet even in the most hierarchical organizations, small groups of solidary workers form mutual-aid structures within the bowels of the organization (Thompson, 1967). Shops, factories and offices frequently contain dense, bounded, groups in which a limited number of people are fully engaged with each other in doing a collective task, be they clusters of artisans, sets of assembly-line workers, or small software development firms. They may be a permanent feature of the organization, or they may be a temporary group setup within a large organization to solve specific work tasks, as when Data General created a team to develop a new mini-computer (Kidder, 1981). The work in these groups is physically typified by open office plans with co-workers having full visual, aural and physical

access to each other. Participants often describe their situation metaphorically as "working in a fishbowl". Almost all communication is inward, within the fishbowl. Such a group situation is typical of tiny computer start-up companies where each programmer is in constant visual, aural and computer network (Coupland, 1995). There is considerable cross-talk, both on-line and face-to-face (see also Haythornthwaite, et al., 1995).

Community: Even more than the conceptualization of work, healthy communities have come to be viewed as densely-knit, tightly-bounded groups. Researchers have found that despite the traumatic changes of modernization, communities continue to flourish. People still neighbor, visit their relatives and help each other. These are necessary refuges from outside pressures, sources of interpersonal aid in dealing with large bureaucracies, and useful means of keeping streets safe (Wellman, 1988a).

The celebration of dense, bounded village-like groups of community and work pervades one strain of thought about computer mediated communication. Many see it as a boon for the alienated and isolated who will no longer be huddled in front of their television screens. Rather, video screens have become magic communicators enabling people to use on-line discussion groups, bulletin board systems, virtual chat rooms, and the like to make meaningful contact around the world with newfound comrades (Rheingold, 1993; Wellman & Gulia, 1996). For example, Phil Patton predicts that "computer-mediated communication... will do by way of electronic pathways what cement roads were unable to do, namely connect us rather than atomize us, put us at the controls of a `vehicle' and yet not detach us from the rest of the world" (1986, p. 20). As the co-founder of the Electronic Frontier Foundation prophesies:

> With the development of the Internet, and with the increasing pervasiveness of communication between networked computers, we are in the middle of the most transforming technological event since the capture of fire. (p. 36).... I want to be able to completely interact with the consciousness that's trying to communicate with mine.... We are now creating a space in which the people of the planet can have that kind of communication relationship (Barlow, et al., 1995, p. 40).

Sparse, Unbounded Networks

Work: In practice, many people do not work in either alienating mass workplaces or in small dense and bounded workgroups, and many organizations are not heavily composed of compartmentalized groups structured into tree hierarchies. Such people often accomplish their work in such loosely-coupled, open organizations through selective contacts with shifting sets of others (Kling & Jewett, 1994; Star, 1993; Weick, 1976). They are in work relationships that routinely cut across departmental boundaries, and they have multiple reporting relationships that are segmented by time and task. The relatively autonomous workers in such sparsely-knit, unbounded networks switch frequently and routinely among the people with whom they are dealing throughout the day as they move from project to project or as they need different kinds of resources. This mode of work is often found among professionals who have to make multiple, often unexpected contact with colleagues within and outside their own organizations. An archetypical situation is a "brokerage" where an intermediary links two strangers in a transaction, be it stocks, houses or marriage (Abbott, 1988). It is also the nature of "scholarly communities" of far-flung academics sharing similar research interests (Star, 1993; Walsh & Bayama, 1996; Carley, 1990; Kaufer & Carley 1993). Yet not only

professionals work this way. Similar forms of interaction occur among managers in some large organizations, blue-collar workers with a responsibility for a range of tasks, and socially-independent workers such as truck drivers (Shrum 1990). Physically typified by closed (or home) offices, such workers often conduct individual contacts and much of their work in relative privacy. Co-workers who want to talk with them may have to knock on doors or hope that a telephone is answered. Rather than being a member of one all-encompassing group, such workers have limited interactions with many different members of their networks, either one-to-one or in small, frequently changing, sets (Burt 1992).

Community: Just as loosely-coupled network forms of cooperative work have become prevalent in the western world, sparsely-knit, unbounded communities also flourish. Although major changes in social, economic and political organization have not destroyed community, they have profoundly affected the contexts within which daily lives operate (Fischer, 1984). Since the 1960s, sociologists have discovered that dense, bounded neighborhood and kinship ties are often only a portion of people's overall community networks, because cars, planes, phones and computer mediated communication can maintain relationships over long distances. Just as cooperative work need no longer be defined in terms of co-located work groups, community need no longer be defined in terms of neighborhoods. There has been a paradigm shift away from definitions in terms of locality and solidarity and towards definitions in terms of social networks. Such communities are ramified and complex networks of kin, friends and workmates who do not necessarily live in the same neighborhoods. Although the world is not a global village (McLuhan 1962), one's "village" can span the globe (Wellman, 1988a, 1994).

Researchers have learned that such communities are: *domestic*, operating from a person's home rather than from relatively accessible public spaces such as pubs, cafes and street corners; *private*, operated by each person rather than by a collectivity such as a kinship group or tribe; *specialized*, with different ties providing different types of resources; *sparsely-knit*, so that most of the people in the network are not strongly connected with each other; *fragmented*, so that most people are members of a number of specialized multiple communities rather than being engulfed in a single all-embracing community (Wellman, 1994).

This form of community resembles how many social relationships are conducted over the internet and other forms of computer supported social networks. Sitting in the privacy of their homes, people connect on-line with fellow members of newsgroups and other usually-specialized forms of virtual communities (Danet, Wachenhauser, Bechar-Israeli, Cividalli & Rosenbaum-Tamari, 1995). Such virtual communities inherently connect all directly with all -- everyone can read all messages -- but their size and fragmentation means that few members are strongly connected. Hence computer supported social networks are not destroying community but are responding to, resonating with, and extending the types of community that have already become prevalent in the developed Western world (Wellman & Gulia 1996).

Relating Social Network Characteristics to Computer Mediated Communication

Although the distinction between densely-knit, bounded groups and sparsely-knit, unbounded networks is a frequently-made ideal-type, social networks can be described in more complex and multivariate ways. In this section, I discuss the implications of six characteristics of social networks for understanding on-line social relationships and social organization: density, boundedness, range,

exclusivity, social control and tie strength. As many of these characteristics are associated with each other, I organize the discussion in terms of how these characteristics are manifested in dense, bounded groups or sparse, unbounded networks (see also Mantei & Wellman, 1995).

Density

Social Networks: Do all network members have contact with all others, or is each the center of a unique, sparsely-knit social world? *Dense, bounded* groups have considerable communication among members.[5] Within the group, ease of access promotes connections among all members. Almost all contacts between all persons in the network are made and usually made frequently. A classic example is the densely-knit networks of London kin described by Bott (1971) where the parents and siblings so controlled husbands and wives that they tended to lead independent lives.

By contrast, few members of *sparse, unbounded* networks communicate directly and frequently with each other. For example, our research group has found that the density of Torontonians' intimate personal communities to be 0.33, that is, only one-third of all possible intimate ties between the average person's socially-close intimates actually do exist (Wellman, Carrington & Hall, 1988). The resulting lack of communication among intimates means that a person must work harder to maintain each relationship separately. However, the structural holes in their networks also provide them with opportunities for maneuver (Burt, 1992).

Computer Networks: Computer mediated communication supports both dense, bounded groups and sparse, unbounded networks. *Dense groups* are supported when all participants in computerized conferences read and respond to all communications and so are directly connected to each other on-line. Focused task groups, role-playing MUDs (multi-user dimensions) and some newsgroups resemble village-like structures when they capture their participants' attention (Kollock & Smith, 1996). Thus work groups using computer mediated communication have a higher level of communication than those that do not (Bikson & Eveland, 1990), although a high level of on-line communication may reduce the use of face-to-face and telephone contact (Finholt & Sproull, 1990; Finholt, Sproull & Kiesler, 1990). Moreover, the forward-and-copy features of most electronic mail (e-mail) systems can increase network density. Forwarding communications to third parties provides indirect connections between previously-disconnected people, as they become aware of each other's mutual interest. The ease of reply can transform an indirect tie to a direct tie.

Densely-knit, on-line groups are also apt to be mutually supportive, with exchanges of help often forming a complex web of assistance among several group members. Motivations for providing assistance on a computer network are partially founded on norms of generalized reciprocity and group citizenship. People who have a strong attachment to the on-line group will be more likely to participate and assist others, even total strangers (Kollock & Smith, 1996; Constant, Sproull & Kiesler, forthcoming).

Computer networks are well configured to support participation in *sparse, unbounded* networks. People can quickly send private e-mail to anyone whose address they know, they can belong to a number of computerized conferences, and they can easily send messages to separate personal distribution lists for different kinds of conversations and activities. Moreover, they can vary their involvement in different work groups and communities, participating actively in some and occasionally in others.

Boundedness

Social Networks: Boundedness refers to the proportion of network members' ties that stay within the boundaries of the social networks (Laumann, Marsden & Prensky, 1983). All networks are defined within a population, be it a workplace, a neighborhood, a set of organizations (networks can link organizations as well as people), or the world system. Networks can be bounded groups or permeable ramifying networks in which people can reach out widely to connect with others. In *tightly-bounded* networks (almost) all of the relationships remain within the population. Those that cross the population's boundaries are likely to be relationships maintained by a few gatekeepers, such as workgroup managers, who have routinized contact on behalf of the group with the rest of the organization, neighborhood, etc. Tightly-bounded groups have important implications for the flow of information, disease and social resources. For example, the tight boundaries around the networks of those in the U.S. with AIDS has limited the spread of the disease to the general population (Laumann, Gagnon, Michael & Michaels, 1994).

By contrast, the members of *loosely-bounded* (or *"unbounded")* networks have many ties with people who are not members of this particular network. Their orientation to a network will not be as intense. Because so many ties go outside the network, it is likely that the network will be sparsely-knit. For example, purchasing agents and sales people often are on the organizational margins, developing strong bonds with people they buy from or sell to, at the cost of their loyalty to their own organization (Bristor 1987; Dorsey, 1994).

Not only do networks link people, they link groups, for when ties connect two groups, they provide intergroup as well as interpersonal links. (Breiger, 1974, p. 181, calls this "the duality of persons and groups"). Moreover, networks are scalable as "networks of networks" (Craven and Wellman 1973): interpersonal, intergroup, interorganizational, and international. Thus if two persons who are members of two different workgroups or organizations are linked, their interpersonal tie is also an intergroup or interorganizational one. Thus the largest American corporations are linked in one densely-knit network through the membership of their officers on each other's governing boards (Levine, 1986; Mintz & Schwartz, 1985). The logic and the analysis are quite similar to computer networks: Connectivity between local area networks creates an organizational network, while connections to the internet support inter-organizational computer networks.

Computer Networks: Local and wide area computer networks can support *dense, bounded groups,* through computerized conferencing and distribution lists in which all can send and receive messages with all. Indeed, many organizations put tight boundaries around their computer networks to inhibit communication from leaving the organizational precincts and to forestall intrusion. Technical constraints may also reinforce tight boundaries. At present, multimedia systems such as *Cavecat* and its descendants, *Telepresence* and *Corel Vision*™, only have the ability to support videoconferencing among a small set of participants who also have the necessary equipment. Participants are aware of who is available for interaction through slow-scan video snapshots and can then use computer commands to establish video links with another person or even a small group (Mantei, Baecker, Sellen, Buxton, Milligan & Wellman, 1991; Buxton 1991).

Many computer networks support *unbounded* social networks because both private e-mail and computerized conferences makes it easy and inexpensive to maintain connections with distant acquaintances and form new ties with strangers. Such "weak ties" are usually better connected to

other, more diverse social circles and hence are more apt to be sources of new information (Granovetter, 1982). Information may come unsolicited through distribution lists, computerized conferences, forwarded messages from friends who "thought you might like to know about this," and direct e-mail from strangers ("a mutual friend recommended that I contact you").

The lower social presence of e-mail --as compared to in-person meetings or telephone conversations -- makes it easier to contact strangers because there is less concern about rude intrusion or interpersonal risk (Stoll, 1995). The willingness of people to engage on-line contrasts with in-person situations where American bystanders have been reluctant to help strangers (Latané & Darley, 1976). Yet such bystanders are more apt to intervene when they are the only ones available to help or can withdraw easily in case of trouble. Analogously, on-line requests for aid are read by people alone at their screens. Even if the request is to a computerized conference and not by personal e-mail, a recipient of requests may believe that s/he may be the only one who can provide aid. In computerized conferences, even when such support is a small act such as mailing get-well cards or "cyber chicken soup," such acts can cumulatively sustain a group. Each act is seen on-line by the entire group and perpetuates a norm of inclusionary mutual supportiveness in the organization or community (Rheingold, 1993).

Social processes can make loosely-bounded networks develop tighter boundaries. Computer networks can integrate new workers into communication channels and culture and increase commitment (although an initial period of physical proximity may be necessary to build trust and consensus). Such networks have knit dispersed professionals, technicians, administrators or sales personnel into "highly cohesive and highly cooperative ... groups, ... geographically dispersed yet coordinated" (Carley & Wendt, 1991, p. 407; see also Eveland & Bikson, 1988; Rice & Steinfield, 1994: Steinfield, 1986; Sproull & Kiesler, 1991; Walsh & Bayama, 1996). By contrast, researchers at different locations rarely co-authored papers before the advent of e-mail (Galegher, Kraut & Egido, 1990).

Computer networks often blur or shift the boundaries of work groups, organizations and communities. They aid organizations to develop work teams that span unit boundaries, they facilitate interorganizational coordination of joint projects, and they easily link buyers and sellers in different organizations. They help people to maintain a stockpile of potentially useful contacts outside of their work group, organization or community that can provide information, instrumental aid and emotional support. For example, more than half of the e-mail messages in one organization were from unknown people, different buildings, or people external to the work group or the chain of command (Finholt & Sproull, 1990; Sproull & Kiesler, 1991).

The internet is an extreme example of an unbounded network. Its population boundary approaches infinity and is so in flux that it cannot be analyzed at any one time. Although it is inherently impossible to map all internet relationships (or Web site hyperlinks), ego-centered analyses can trace the nature of the connections of a sample of internet users. Another way to study the internet (and other unbounded networks) is to trace flows of resources. For example, we are currently replicating Milgram's "small world" study (1967) by asking randomly-selected internet users to try to contact a target person whom they may or may not know. If they do not know the person, they are asked to forward our message to someone in their social network and also copy the message to us. This is enabling us to trace the flow of messages through the internet, seeing how

close two nodes are to each other in terms of the links needed to connect them (Dantowitz & Wellman, 1996; see also Schwartz & Wood, 1993)

Range

Social Networks: The range of a network describes how large and diverse is the population within its boundaries.[6] With larger size comes the population basis for more heterogeneity in the social characteristics of network members (Wellman & Potter, 1997) and more complexity in the structural patterning of ties in networks. *Dense, bounded* networks almost always have a small range because a large network becomes unbounded relatively quickly. As the number of network members increases the population basis for more diversity within the network increases. Moreover, as the number of network members increases arithmetically, the number of connections required to sustain full connectivity increases geometrically.

Where dense, tight networks with small range are good for conserving existing resources, sparse, loosely-bounded (unbounded) networks with a large range are good for obtaining additional resources. *Sparse, unbounded* networks with a large range provide the number of network members and the diversity for people to obtain a wide range of resources. Such large and heterogeneous networks tend to be structurally complex. Instead of a uniform distribution of relationships (as in densely-knit networks), ties in networks with a large range tend to form clusters that only a few ties bridge (Granovetter, 1973). Hence, resources (such as information) tend to flow unevenly through these networks and the network members whose ties are bridges tend to accrue both power and suspicion as gatekeepers to other clusters. Espinoza's (1996) study of Santiago, Chile *barrios* is a good example of the strengths and limits of networks with low range. The small, homogeneous networks of kin and neighbors are excellent in providing mutual aid but of little use in getting employment outside of the neighborhood.

Computer Networks: Computer networks increase the range of social networks, facilitating more relationships and a wider range of relationships. The asynchronous nature and distance-free cost structure of computer networks transcends spatial limits, thereby allowing people to communicate over different time zones and enabling more active contact in otherwise latent relationships. People can greatly extend the number and diversity of their social contacts when they become members of computerized conferences or broadcast information through distribution lists. Computer networks enable people to maintain a larger number of ties on-line than they probably could face-to-face. Computerized conferences and distribution lists provide permeable, shifting sets of members, with more intense relationships continued by private e-mail. The resulting expansion of the size and proximity of one's on-line "communication audience" can increase the diversity of people encountered (Lea & Spears 1995). For example, four-fifths of the e-mail of one large, physically dispersed organization were from electronic groups and not individuals (Finholt & Sproull, 1990; Sproull & Kiesler, 1991). In another organization, an on-line work team formed more subcommittees than an off-line team and was better able to involve its members in its activities (Bikson & Eveland, 1990).

The relative lack of social presence on-line fosters relationships with people who have more diverse social characteristics than might normally be encountered in person. It also gives participants more control over the timing and content of their self-disclosures (Walther, 1995). Often, the only thing known about others are their signatures which may provide minimal or misleading information

(Slouka, 1995). This allows relationships to develop on the basis of shared interests rather than to be stunted at the onset by differences in social status (Hiltz & Turoff, 1993). In the absence of social and physical cues, people are able to get to know each on-line from their communication exchanges and decide later to broaden the relationship or expand it off-line to the telephone or in-person meetings (King, 1994). It is possible that allegiance to computerized communities of shared interest may become more powerful than allegiance to one's physical neighborhood for one study has found strong commitment to on-line groups that were perceived to be longlasting (Walther 1994).

Thus many computer supported social networks are a continuation of the long term shift to communities and work groups that are organized by mutual interests rather than by shared neighborhood or work site (Fischer, 1984; Wellman & Leighton, 1979). The lack of on-line cues about socially-status promotes socially heterogeneous connections across hierarchical or other forms of status barriers (Eveland & Bikson, 1988; Sproull & Kiesler, 1991). (However, it can also encourage the formation of networks that are culturally homogeneous because they are composed of people sharing similar concerns and values (Lea & Spears, 1992).) The relatively egalitarian nature of on-line contact can be empowering for those with disenfranchised social categories because there is little overt communication about one's gender, age, race, ethnicity, life-style, socioeconomic status, organizational position or membership in cliques (Culnan & Markus, 1987; Hiltz & Turoff, 1993). However, participation on-line changes once people know the social characteristics of others (Weisband, Schneider & Connolly, 1995). Consider the experience of "Amy" in Douglas Coupland's novel, *Microserfs:* "Reveal your gender on the Net, and you're toast" (1995, p. 334; see also Herring, 1996; Shade, 1994).

Exclusivity[7]

Social Networks: Do people interact primarily one-on-one or are their individual contacts available to a wider set of persons? The control that co-workers and community members have over access to each other can vary between little control/high access in dense bounded groups to high control/low access sparse unbounded networks. In addition to variation in discretion over contact with network members, there can also be variation circumstances under which people can be interrupted (privacy) and or others can have access to their work (e.g., control over files).

Dense, bounded groups tend to be in situations where there is relatively little choice of network members, and little control over access and interactions. Common examples are kinship groups, isolated villages, and focused work teams where people are expected to work with whom they are assigned and to find community with their neighbours. Members of such groups share their activities with all others in the group, and many discussions and interactions are observed by all without any normative claims to privacy. One classic account is of the "bank wiring room workers" in a Western Electric plant who ensured that potential "ratebusters" did not work so hard as to drive up production norms (Roethlisberger & Dickson, 1939). By contrast, *sparse, unbounded* networks afford people more discretion in the persons, places, and times of their interactions. Such networks frequently have more physical barriers to access and interaction. Many sparsely-knit workers occupy private offices where entry is only by invitation, and it is rare for a North American to go bounding into another's home without a previous invitation and a knock on the door (Michelson 1976). Because of the difficulty of coordinating sparse networks, interactions are more apt to be one-on-one, and much information tends to be privately held within a dyad or selectively shared with sparsely-knit sets of similarly-minded network members.

Computer Networks: Computer networks can be constructed to support either dense, bounded groups or sparse, unbounded social networks. For example, the *Cavecat* and *Telepresence* systems designed software that made sounds simulating knocking at a door when someone wanted to videoconference with another (Mantei, et al. 1991; Buxton, 1991. At the other end, participants in this system could set their "door states" to allow a video connection to be made without knocking (door icon set to wide open), with knocking (door icon ajar), or not at all (door icon closed). It would have been even easier to design software in which no knocking was need, thereby providing the immediate access that is common in dense, bounded groups. With respect to messages, many computer networks within organizations allow people to learn who has read the relevant messages while at least one software scheme also structures requests for responses and taking actions (Winograd, 1988). By contrast, although the internet (like the telephone system) technically allows all to send messages to all, software filters (as well as human assistants) can screen out unwanted messages.

At a more macroscopic scale, the proliferation of computer supported social networks both extends and counteracts the contemporary shift away from dense, bounded groups and to sparse, unbounded networks. To some extent, by confining people to their computer screens, computer mediated communication has intensified privatized, exclusive relationships by turning people away from face-to-face relationships in public. Yet it is the highly-privatized watching of television screens that is the modal leisure activity in the western world. Hence computer mediated communication may actually be enhancing community because computer networks support public computerized conferences as well as private e-mail exchanges. Because all members of computerized conferences can read all messages -- just as when a group talks in a café or an open office -- groups of people can talk to each other casually and get to know the friends of their friends. "The keyboard is my café," says William Mitchell (1995, p. 7).

Social Control

Social Networks: How do external sources create, constrain and manage a person's contacts and exchanges? At work, people may be embedded in a flat, matrix or tree-hierarchical organizations. Their community life may be subject to extensive social control by peers and influentials, or they may be able to maneuver among multiple, partial communities and keep their involvement in each community secret from the other networks in which they are involved. Controls for managing normative social behavior in *dense, bounded* groups are usually enforced by group pressure, work supervisors and community influentials to ensure that participants work together for clearly-defined collective goals.

There is less social control in *sparse, unbounded* networks because of their weak interconnectivity. The greater fragmentation of these networks means that people can avoid portions of the network where they are unwanted. No single supervisor or influential exists, and contact with higher-status people is often weak and infrequent. Rather than being an externally-disciplined corporate army, internalized norms and standardized organizational procedures control loosely-coupled workers and community members (Abbott 1988; Suttles 1968). For example, in the "Blue" organization, the flow of communication through complex social networks creates discipline: organizing work processes and ensuring that tasks are completed (Wellman, Salaff, Dimitrova, Garton & Haythornthwaite, 1994).

Computer Networks: There is an inherent tension between management's desire to maintain control and those attributes of e-mail that weaken network boundaries. Managers of *sparse, bounded* work units worry that they will lose control over information and work practices if they set up e-mail systems, connect within-organization "intranets" to the outside world of the internet, and allow workers to chat privately on-line. They fear that computer networks will threaten control as the networks accelerate the flow of (mis)information, including rumors, complaints, jokes and subversive communications (Finholt & Sproull, 1990; Zuboff, 1984). Even when organizations explicitly encourage informal e-mail, managers often view it with distrust. Hence system administrators may monitor on-line activities and read e-mail and files. In one organization, network administrators promoted the "appropriate" use of the computer network and admonished those who used it for recreational or non-organizational purposes (Orlikowski, et al., 1995). As such behavior can alienate workers who value their autonomy and have alternative job prospects, a tacit norm has developed that e-mail is private unless access to on-line files are needed when a worker is seriously ill, out of communication, or suspected of illicit work behavior (Sipior & Word, 1995).

Yet e-mail itself can be used to extend managerial control, a practice revealed in its negation when some workers in an outlying branch never turned on a multimedia communication system that would have facilitated the central office's awareness of them (Wellman, et al. 1994). However, Sproull & Kiesler (1991) suggest that attempts to use computer supported social networks to strength central control may lead to organizational conflict. They forecast that management practices may change to *sparse, unbounded* networks where "people work in multiple groups, when groups are composed of members who collaborate only electronically, and when soft structures emerge without management directive" (p. 160). Moreover, the limited social presence of computer mediated communication is conducive to the kinds of uninhibited remarks, non-conforming behavior and diverse opinions that are characteristic of sparse, unbounded networks (Hiltz, et al., 1978; Siegal, et al., 1986; Sproull & Kiesler, 1991; Lea & Spears, 1992; Walther, et al., 1994).[8]

The sparse, unbounded nature of the internet means that people unhappy with one interaction can maneuver between different computerized conferences and private e-relationships. They might maintain a dignified persona in several milieus and be a ferocious "flamer" (sending abusive e-mail), "spammer" (sending junk e-mail to many groups) or "cyberpunk" in others. When people belong to multiple social networks, no one network has exclusive control over them. The narrow focus of computerized conferences allows people to take risks in specialized relationships that may only exist in a single, partial, on-line social network. Some computer supported social networks allow people to be anonymous or to use nicknames when they want to speak freely or try on different personas. The practice allows the maintenance of public communication networks while maintaining privacy (and protecting participants for retribution). It is more prevalent among virtual communities although it also has some advantages for the free flow of ideas in work situations (Bechar-Israeli, 1995; Hiltz & Turoff, 1993).

Strength of Relationships

Social Networks: The strength of relationships is a multidimensional construct encompassing the usually correlated variables of a relationship's social closeness, voluntariness, "multiplexity" (breadth) and, to a lesser extent, frequency of contact (Granovetter, 1982; Wellman & Wortley, 1990).[9]

Strong ties tend to provide more social support than weak ties: emotional aid, goods and services, companionship, and a sense of belonging. They also provide a wider variety of such social resources (Wellman, 1992). But weak ties are not useless. Their very weakness means that they tend to connect people who are more socially dissimilar than those connected through strong ties. Consequently, weak ties tend to link people to other social worlds, providing new sources of information and other resources (Granovetter, 1982, 1995).

In *dense, bounded groups,* relationships tend, somewhat paradoxically, to be both involuntary and socially close. Involuntary groups such as isolated villages and corporately-formed work groups exist because the situation fosters the tie and not because people choose to be together. Yet the high frequency of contact in these groups and the wide range of activities that group members do together creates socially close intimacy, whether the participants like it or not.

By contrast, relationships are more likely to be entered into voluntarily in *sparse, unbounded* networks whose participants have come together on the basis of a common interest or mutual advantage. Most friendship relationships are like this, but so too are work relationships when, for example, professionals have some discretion about who they consult or managers are able to ask volunteers to join a work team. Such discretion has some costs because each tie must be maintained separately whereas the stronger social controls of dense, bounded groups do much of the work of maintaining ties. Because each tie operates separately, ties in sparse, unbounded networks tend to be more variable than those in dense, bounded networks in terms of what network members do together, how supportive they are, and how frequently they are in contact.

Computer Networks: Can the medium support the message? Research is showing that despite the more limited social presence of computer mediated communication, on-line relationships are often strong with frequent, supportive and companionable contact (Sproull & Kiesler, 1991). They are voluntary relationships in all virtual communities and many work situations. The ease and placelessness of e-mail contact facilitates frequent and longterm contact, without the loss of the tie that so often accompanies geographical mobility.

If e-mail were solely a means of information exchange, then on-line relationships would only be *narrowly specialized* rather than be *broadly multiplex.* Yet those who communicate on-line maintain a variety of links, encompassing information exchange, companionship, emotional aid, arranging services, and providing a sense of belonging (Hiltz, Johnson & Turoff, 1986; Walther, 1994). For example, while the majority of elderly users of "SeniorNet" reported joining the Net to gain access to information, nearly half had also joined to find companionship and the most popular activity was chatting with others (Furlong, 1989). Another on-line conference, "Systers," was originally designed for the exchange of information among female computer scientists but turned into a forum for networking and exchanging support (Sproull and Faraj, 1995). In another situation, the members of a university computer science laboratory use e-mail extensively for emotional support. As much of their time is spent on-line, it is natural for them to use e-mail to communicate these problems to confidants. Moreover, when these confidants receive an on-line message of distress, it is easy for them to use the network for support (Haythornthwaite, et al., 1995).

Although computer supported social networks do sustain broadly multiplex relationships, they are particularly suited for fostering specialized relationships. The internet encourages specialized relationships because it supports a market approach to finding social resources through on-line

relationships. With more ease than in almost all situations, people can surf internet e-mail, newsgroups and search the Web for resources within the safety and comfort of their homes or offices and with reduced search and travel time. Participants can browse through specialized conferences on the internet and commercial services before deciding to join a discussion (Bechar-Israeli, 1995). Relationships in these conferences are often narrowly defined, although the inclusion of e-mail addresses in most messages provides the basis for more multiplex relationships to develop.

Are such on-line relationships *socially-close* enough to be strong ties? Some concerns about whether on-line communication can sustain strong ties are wrongly specified because both enthusiasts and critics tend to speak of relationships as functioning only on-line. Their technological fixation leads them to ignore the abundant accounts of community and work ties that operate off-line as well as on-line, with e-mail being just one of several ways to communicate. Much on-line contact is between people who see each other in person at work or in the community. As with the telephone and the fax, the lower social presence of e-mail can maintain strong ties between persons who originally met face-to-face. E-mail exchanges intersect with in-person meetings, filling in gaps and making arrangements for future get-togethers. Conversations started on one medium may continue on others. In one organization, office employees communicate by e-mail while they physically work side-by-side. This allows them to chat while giving the appearance of working at their computers (Eveland & Bikson, 1988; Finholt & Sproull, 1990; Garton, 1995; Haythornthwaite, et al., 1995; Hiltz & Turoff, 1993).

Can relationships be strong if they are only sustained on-line? Some analysts have argued that the comparatively low social presence of computer mediated communication cannot by itself sustain strong ties because of the lack of physical and social cues and immediate feedback. Others have contended that computer mediated communication is rich enough to sustain intimacy (see the reviews in Garton & Wellman, 1995; Sproull & Kiesler, 1991). Indeed, there are many stories of high involvement in on-line relationships, at times to the sacrifice of real-life domestic relationships (Hiltz & Turoff 1993; Barlow 1995; Rheingold 1993; Kling 1995). For example, some participants of a computerized conference came to feel that their closest friends were members of this on-line group, whom they seldom or never saw in person (Hiltz & Turoff, 1993).

Many on-line ties probably are "intimate secondary relationships": moderately strong, informal, frequent and supportive ties that operate in only one specialized domain (Wireman, 1984). Over time, some of these relationships may become more personal and intimate. Perhaps the limited social presence and asynchronicity of computer mediated communication only slows the development of strong ties, with on-line interactions eventually developing to be as sociable and intimate as in-person ones (Walther, 1995).

Computer Supported Social Networks: A Research Shopping List

There are more types of networks on the ether or earth than those who talk only of "groupware" have dreamed of. But does the computer-supported proliferation of unbounded, specialized networks portend the end of western civilization as we know it?

Many of those fearful that virtual community is not "real" community and that computer supported cooperative work will create alienated workers are confusing the pastoralist myth of community and work for the present reality. Community ties are already geographically dispersed, sparsely-knit, specialized in content, and connected heavily by telecommunications (phone and fax).

Although virtual communities may carry these trends a bit further, they also sustain in-person encounters between community members.

Work is also becoming less of a group activity and more of a network phenomenon, as the shift from manufacturing to information services lessens the importance of co-location. Many workers are involved in multiple work teams rather than solidary groups, and they are as apt to work with colleagues across the country as to those in the next seat. It is the computerized flow of information that drives their work and not the office boy handing out the day's "snail mail".

It is clear that computer networks support sparse, unbounded networks as well -- or sometimes better -- than dense, bounded groups. Yet the early state of systematic research into computer supported social networks has raised more questions than even first-approximation answers. There are too many arguments by assertion and anecdote in this literature, and too much research that ignores the social context in which on-line communication takes place. The subject is important: practically, scholarly and politically. The answers have not yet been found. Indeed, the questions are just starting to be formulated. Here is a preliminary list of some basic questions to put on research agendas:

Modality

1. What are the modalities of using the Net? To what extent do people use private e-mail, group e-mail, distribution lists or Usenet newsgroups. How do these different modalities link together in people's practices? To what extent do they connect with uses of Web sites, such as personal home pages, hyperlinks to others, and accessible on-line documents?

2. To what extent are on-line relationships and virtual communities free-standing or integrated into other modes of communication, such as in-person get-togethers, telephone calls, or written communications?

Density

3. What is the structure of virtual communities and computer supported cooperative work teams? How densely knit are they? Do cliques and clusters tend to form, and if so, on what principles?

Boundedness

4. Is there a natural history to on-line relationships? How do they get founded, maintained, transformed or die?

5. How many people are using the internet? (This is a question that is difficult to answer precisely because the internet is actually a "network of networks," so that a two-tiered census would have to be taken of nodes and persons.) What are the social characteristics of participants?

6. How interconnected is the on-line world? How many on-line steps would it take to connect any two network members (an updating of the "small world" question originally asked by Milgram 1967)? How many on-line steps would it take to connect the entire world (a question originally studied off-line by Rapoport, 1957)

Scale

7. What is the composition of people's personal networks on-line in terms of the similarity of their social characteristics?

8. To what extent are on-line relationships based on shared interests, similar social characteristics or the sheer need for frequent communication (as between two neighbors or coworkers)?

9. Are people with socially disadvantaging characteristics (such as women, visible minorities, shut-ins, residents of the countryside, and the poorly educated) more or less empowered through on-line networks What is the extent of their membership in computer supported social networks? If they are members, what is the extent of their involvement?

Exclusivity

10. Can computer supported social networks form the basis for political mobilization on a non-territorial, shared interest basis? Can such networks supply empowering information and is it possible to build teledemocratic community forums on-line to sustain civic life? (See the discussions in Johnson-Lenz & Johnson-Lenz 1993; Hiltz & Turoff 1993; Ogden 1994)? Will existing structures of power be open to such challenges?

11. Under what circumstances will private e-mail exchanges at work and in the community become overshadowed by more public forums such as computerized conferences?

12. Will surveillance agencies develop easy means of monitoring on-line exchanges, automating them to overcome their presence reliance on labor-intensive procedures? If successful, will such surveillance engender movement away from on-line relationships for sensitive matters?

Social Control

13. How has the proliferation of computer supported cooperative work changed the broader structure of organizations heavily involved with it?

14. What is the prevalence of deviant behavior on-line, such as harassment or hacking? What kinds are actually prevalent?

Strength of Ties

15. What is the composition of people's personal networks on-line in terms of the strength of their relationships?

16. How durable are on-line relationships? How much turnover are there in virtual communities? How does the distribution of involvement in virtual communities and computer supported cooperative work teams compare with involvement off-line?

17. How prevalent is active membership in multiple virtual communities and work teams? Do there tend to be some patterns in these memberships, such as maintaining a balance between instrumental and affective involvements?

18. What is the content of on-line relationships in terms of supplying companionship, information and various types of instrumental and affective support?

Notes

1. Although both "group" and "network" are really social networks, the linguistic distinction is well-established in everyday discourse.

2. I am grateful to Sara Kiesler for suggesting the argument in the preceding two paragraphs.

3. It is noteworthy that in these two organizations there was little telephoning, faxing or circulation of paper memos.

4. The most widely-used software package for tailored for doing social network analysis is *UCINet* (Borgatti, Everett & Freeman, 1994). Others are *Gradap* (Sprenger & Stokman, 1995), *Multinet* (Richards, 1994), and *Structure* (Burt, 1991). All run on DOS-based microcomputers. However, much network analysis can be done using standard general-purpose statistical packages such as *SAS* and *SPSS* (Haythornthwaite & Wellman, 1996a; Wellman, 1992).

5. *Network density* is a variable (ranging from 0.00 to 1.00) describing the proportion of all possible ties (between two network members) that actually exist. A very densely-knit network, with a density of 1.00 or so, would have a line connecting every point to every other point. (In an interpersonal network, every person would be directly connected with every other.) In graph theory (and social network analysis), such a fully-connected network is called a *clique.* In practice, only very small networks tend to be fully connected, so researchers usually study *densely-knit* networks in which most possible connections actually exist. There is no standard definition of where a network becomes densely-knit (it is a continuum), but most researchers would apply this term to a network with a density of at least 0.67 (two-thirds of all possible ties actually exist). *Sparsely-knit* networks are at the other end of the continuum where few ties connect network members. The basic way to measure network density is to create a matrix in which the members of the network are crossclassified by row and column. A "1" indicates the presence of a tie while a "0" indicates its absence. (For computational purposes, analysts often put a "1" in the main diagonal, indicating that a person is connected to herself. This facilitates additional manipulation of matrices to discover things such as indirect ties. For further information about measuring density see Wasserman & Faust (1993).

6. *Range* is a combination of network size and heterogeneity which together indicate how many different kinds of people is in a network (Burt, 1983). Unlike network density, there is no standard definition of "range". In a recent study (Wellman & Potter, 1996), our research group measured it by first separately calculating network size (a simple count) and network heterogeneity. Network heterogeneity itself is a complex measure that we calculated by averaging standardized heterogeneity on both (a) continuous variables such as years of education that were measured by standard deviation, and (b) categorical variables, such as role type (kin, friend, etc.) which was measured by Schuessler's Index of Qualitative Variation (Mueller, Schuessler & Costner, 1970). After factor analysis showed range to be a single factor encompassing

both network size and network heterogeneity, we calculate a single combined measure from standardized size and heterogeneity.

7. I thank Marilyn Mahnert for suggesting this term.

8. These two paragraphs are based on a review by Laura Garton.

9. The term, *strong ties*, was coined by Mark Granovetter (1973) in a classic essay comparing them to *weak ties* at the opposite end of the continuum. Granovetter thought that strong ties were some combination of intimacy (or socially-close), voluntariness, multiplexity (interacting in a variety of contexts; i.e., multiple role relationships) and frequent contact. However, our group's studies of Torontonians' personal communities found that only intimacy, voluntariness and multiplexity were so closely associated as to be usable in a combined *tie strength* measure (Wellman & Wortley, 1990). Frequency of contact was separate because people frequently saw neighbors or coworkers with whom they were not intimate and whom they would not voluntarily seek out. As yet, there is no standard measure of tie strength; analysts tend to use some combination of the variables discussed above.

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