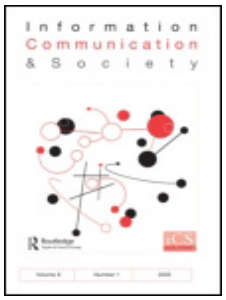

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Caroline Haythornthwaite

SOCIAL NETWORKS AND INTERNET CONNECTIVITY EFFECTS

This paper explores the impact of communication media and the Internet on connectivity between people. Results from a series of social network studies of media use are used as background for exploration of these impacts. These studies explored the use of all available media among members of an academic research group and among distance learners. Asking about media use as well as about the strength of the tie between communicating pairs revealed that those more strongly tied used more media to communicate than weak ties, and that media use within groups conformed to a unidimensional scale, showing a configuration of different tiers of media use supporting social networks of different ties strengths. These results lead to a number of implications regarding media and Internet connectivity, including: how media use can be added to characteristics of social network ties; how introducing a medium can create latent tie connectivity among group members that provides the technical means for activating weak ties, and also how a change in a medium can disrupt existing weak tie networks; how the tiers of media use also suggest that certain media support different kinds of information flow; and the importance of organization-level decisions about what media to provide and promote. The paper concludes with a discussion of implications for Internet effects.

Keywords social networks; computer-mediated communication; latent ties; strong ties; weak ties; communication theory; Internet

Introduction

As use of the Internet and computer networks expands and integrates with everyday life, questions about use are changing from who is 'signing on' to more in-depth analysis of what people do online. Among these considerations is a growing recognition of how the Internet is stimulating connections and forging new links at all levels of organization – grassroots, corporate, institutional, national, global – and a concern that such connectivity may detract from local interaction.

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Early work on computer-mediated communication (CMC) suggested that shifting interactions from rich face-to-face venues to lean, text-based media would create an impoverished communication environment – fraught with misunderstandings, flaming, and antisocial behavior (for early commentary in this area, see Short *et al.* 1976; Sproull & Kiesler 1986, 1991; Culnan & Markus 1987; Lea 1992). Yet, as the new media have become familiar, and their use adapted through common and group conventions (Poole & DeSanctis 1990; McLaughlin *et al.* 1995), they come to function as vital means of maintaining work and social connections in everyday life (Wellman & Haythornthwaite 2002), crossing social worlds of work, home, and geography (Haythornthwaite & Kazmer 2002; Salaff 2002; Haythornthwaite & Hagar forthcoming). More recently, the Internet has been blamed for disconnecting people from local, family interaction, drawing them into online relationships with people of unknown and unconfirmed identity (Kraut *et al.* 1998; Nie 2001). Yet, such ideas are countered by those who see the Internet as presenting the opportunity for keeping connections with family and friends when away at school (LaRose *et al.* 2001) or after moving to a new neighborhood (Hampton & Wellman 2002). All along researchers have seen the benefits of CMC for making connections to distant others with similar interests, satisfying needs not met locally (Culnan and Marcus 1987; Rheingold 1993, 2003; Jones 1995; Constant *et al.* 1996; Wellman *et al.* 1996), and many have written of how online contact can lead to adding face-to-face contact as relationships deepen (e.g. Rheingold 1993; Kendall 2002).

These differing outcomes of CMC and the Internet connectivity generate a lot of discussion, and yet there is little that integrates these effects to explain how such connectivity can be both disengaging and engaging, disruptive of relationships yet also integrative across populations. This paper describes results of studies that give a different view of Internet and media use, one that addresses these disparate results. To gain such a view, it was necessary to expand the discussion of connectivity beyond the usual attention to attributes and use of a single medium to examination of *all media available* to group members, and beyond discussion of who is online to *who is online with whom.* Results from a series of studies of the social networks of communication and media use among academic researchers and online distance students reveal how media use varies with the strength of the tie between communicators. This paper describes these studies and their results, and then the implications they raise for media use and Internet connectivity.

Tie strength and media use

My studies use a social network approach to examine what kinds of relations make up work and learning ties, how these are supported via the available

means of communication, and what patterns of connectivity emerge among group members because of the ties they maintain and the media they use. The results show that different media influence the shape of the network, with particular differences evident between the use of media by those strongly versus weakly tied.

The social network perspective emphasizes the importance of exchanges that support both work and social processes (Wasserman & Faust 1994; Garton *et al.* 1997; Wellman & Berkowitz 1997). A type of exchange or interaction is known as a social network *relation*, and pairs who maintain one or more types of relations are said to maintain a *tie*. Across a set of individuals, person-to-person connectivity builds into *social networks*. Such networks reveal how resources flow and circulate among these individuals, and what subsets or cliques of individuals are more connected than others. The ties maintained by pairs can range from weak to strong according to the types of exchanges, frequency of contact, intimacy, duration of the relationship, etc.

The key difference between a network approach and other kinds of evaluations is that it is the interaction between people that matters, rather than what individuals think or do on their own. In examining uses of the Internet this is reflected in a concern for communication through the net, to others, rather than a human–computer interaction view of individuals' actions and responses to the computer program itself. Looking at what people do and talk about with others is an ideal unit for examining social behaviors, one that promotes asking different kinds of questions about what supports work and learning, and reveals aspects of groups that are not evident from aggregations of individual behaviors. Moreover, the focus on ties connects pair behaviors to group and larger structures, revealing information about activity at local group levels as well as across wider societal levels.

There is already a large amount of research that explores the characteristics of strong and weak ties, which is important for the discussion here. These are summarized in Table 1. (For more on the attributes of weak to strong ties, see Granovetter 1973, 1982; Krackhardt 1992; Walker *et al.* 1994; Wasserman & Faust 1994.) Key among these characteristics is the way those with whom we are weakly tied – people we know a bit but not as close friends – travel in different social circles from us, and thus are more likely to have different experiences from us and access to different information, resources, and contacts. This is the *strength of weak ties* as described by Granovetter (1973). The strength of strong ties, i.e. our close friends and co-workers, is their willingness to work with us, sharing what information and resources they have, and access to the contacts they know.

The studies described here add media use into the network equation, and networks into the media equation, asking members of groups who talks to whom, about what, and via which media. The studies are described briefly

TABLE 1 Differences associated with the strength of ties

weak ties	*strong ties*
Acquaintances, casual contacts, others in an organization	Friends, close friends, co-workers, team-mates
Tend to be unlike each other	Tend to be like each other
Travel in different social circles	Travel in the same social circles
	Experience, information, attitudes & resources, contacts come from same pool
resource and information exchanges	*resource and information exchanges*
Infrequent, primarily instrumental	Frequent, multiple types: emotional as well as instrumental
Share few types of information or support	High level of intimacy, self-disclosure
Low motivation to share information, resources, etc.	Reciprocity in exchanges
strength of weak ties	*strength of strong ties*
Experience, information, attitudes, resources, and contacts comes from different social spheres	High motivation to share what resources they have

to show the background for a theory about ties and media use and the implications for Internet connectivity effects discussed below.

Media use among co-located researchers

The first study examined communication and media use among members of a co-located academic research department, given the pseudonym Cerise (Haythornthwaite *et al*. 1995; Haythornthwaite & Wellman 1998). Media included unscheduled face-to-face meetings (e.g. hallway encounters, meeting at the cafeteria); scheduled face-to-face meetings (e.g. classes, regular research meetings); email (both from home and office); phone; fax; and a videoconferencing system that was under development. Twenty-five participants answered a questionnaire that asked 24 questions about how frequently members engaged in a variety of work and social interactions with up to 20 others in the group (reports included information on relations with 10–20 others, covering 378 respondent–correspondent pairs[1]). Factor analysis revealed six dimensions of work and social interaction important to group members: Receiving work (engaged in by 57 per cent of pairs), Giving work (57 per cent), Collaborative Writing (32 per cent), Computer

Programming (56 per cent), Sociability (86 per cent), and Major Emotional Support (7 per cent of pairs). Media use was then examined for these six dimensions. Respondents also reported on the nature of each tie, answering whether the tie was a formal or informal work tie, and whether the tie was with a close friend, friend, acquaintance, or someone with whom they only worked. Results showed that in keeping with expectations from the social network literature, pairs in stronger ties (formal work ties; close friend or friend relationships) maintained a greater number of relations and communicated more frequently than others.

Media use by distance learners

Another series of studies examined media use by members of distributed, distance learning classes (Haythornthwaite 2000, 2001, 2002a, 2003) in the LEEP (Library Education Experimental Program), at the Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign (for a collection of papers on research and practice in LEEP, see Haythornthwaite & Kazmer 2004). Media used include: Internet Relay Chat (IRC) for classes, 'live' office hours, sub-group discussions, and 'whispering' (private contact with named others); Real-Audio for instructor delivery of lectures, with students returning questions via IRC; web-based bulletin boards (Webboards) for class and program-wide discussion; email; phone; and face-to-face on-campus sessions once a semester. Students in four separate classes (class sizes of 14 to 23 students) were asked how often they had engaged in the following relations with each other member of the class: Collaborating on Class Work, Exchanging Information or Advice about Class Work, Socializing, and Exchanging Emotional Support. Media use was then examined for these four relations. In LEEP, students were asked if their tie to others was a close friendship, a friendship, a work-only tie, or a tie with just 'another member of the class'. As for Cerise, the number of relations maintained and frequency of communication increased with closeness of the reported tie.

Along with the studies of in-class interaction, a series of interviews were conducted with students from across the program. These interviews explored whether students perceived a community to exist in LEEP, the characteristics of that community, how they learned to be part of an online program and community, who gave social and emotional support (e.g. for coping with technology, and being an online student), as well as how this fit with other life activities such as home, work, and family (Haythornthwaite *et al.* 2000; Kazmer & Haythornthwaite 2001; Bregman & Haythornthwaite 2003). Along the way, we gained insight into the meaning and significance of

different kinds of online connectivities to these distance students, for whom face-to-face is the supplement to their 'real' online community.

Media multiplexity

In both the Cerise and LEEP environments, indicators of a stronger tie – greater communication, maintenance of more relations (relational multiplexity), and of relations that include emotional and social support – are found hand in hand with the use of *more means of communication*. Asking 'who talks to whom about what and via which media' revealed the unexpected result that more strongly tied pairs make use of more of the available media, a phenomenon I have termed *media multiplexity*. (This result has also been found by Koku *et al*. (2001) for communication patterns of distributed scholars, with those with stronger ties using more means of communication.)

While the number of media used differs by tie strength, *what* is communicated does *not* differ by medium. It does, however, differ by the type of tie: work-only pairs communicate about work relations; pairs who combine work and friendship communicate about both work and social relations; and friends include more emotional and social communication than non-friends. However, none of these kinds of pairs systematically allocates communications of particular types to particular media (Haythornthwaite 2000, 2001, 2002a, 2003).

More significantly for the differential impact of ties on media use (and vice versa) is the finding that, within a group, use of media conforms to a *unidimensional scale*: those who use only one medium, use the same one medium; those who use two, tend to use the same second medium, etc. In the co-located Cerise group, the unidimensional scale for overall communication shows: (1) Face-to-face Unscheduled meetings, (2) Scheduled meetings, (3) email, then (4) 'Other' media, a combination of infrequently used media: phone, fax, and an under-development videoconference system (Guttman scaling: Coefficient of Reproducibility (CR) = 0.92; 10 per cent cutoff (CR = 0.90) accepted as indication of a fit to a unidimensional scale; McIver & Carmines 1981). In two LEEP classes for which the response rate was sufficient to measure conformity to a unidimensional scale, use of media was ordered as: Class F97: IRC, Webboard, email, then phone (CR = 0.99); Class F98: IRC, email, then phone (CR = 0.94).

This ordered pattern of media use reveals that one or at most two media connect nearly everyone in each group, while other media connect only strongly tied pairs. For the distance classes, it is IRC that connects nearly all members of the class – both weakly and strongly tied pairs – with email added to an IRC 'base' only by those with stronger work or friendship ties (see Figures 1 and 2). In class F97 in particular, email connections show a

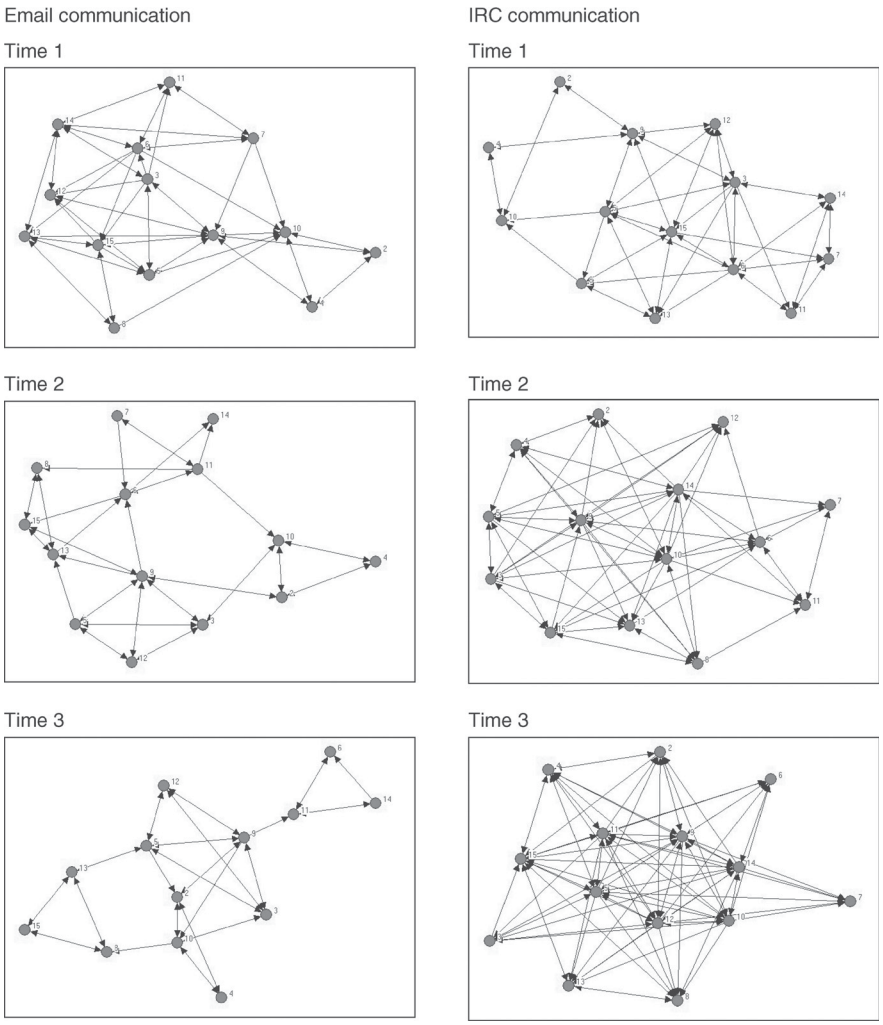


FIGURE 1 Total email and IRC communication over time in class 'F97'

clear association with work ties, as the patterns reflect the arrangement of class members into group projects (see Figure 1). When we look at work and social communication separately in Cerise (Figure 3), we see that email plays a special role for those maintaining closer social ties: communication for overall work is accomplished almost equally via scheduled meetings and email, but socializing via email is reserved for a much smaller subset of overall contacts (note that the Guttman scaling for media use given above was calculated for overall communication). These figures show how media

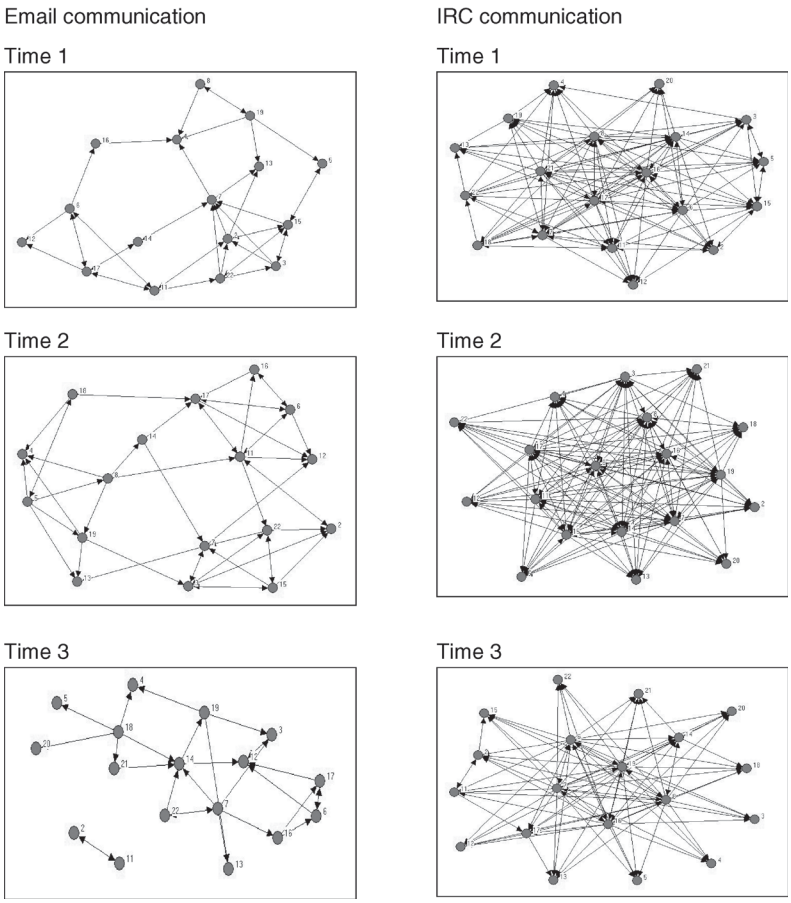
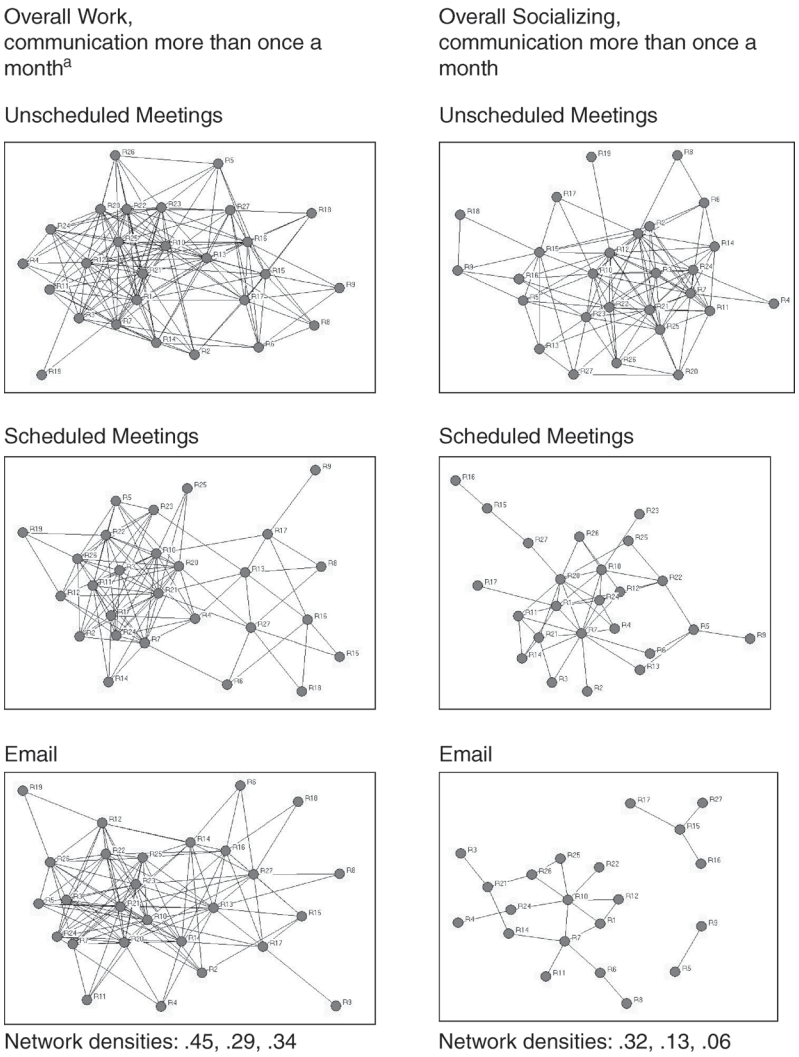


FIGURE 2 Total email and IRC communication over time in class 'F98'

use settles into several *tiers of media use*, each supporting ties of different strengths. They also show that across these groups there are media-based, group-wide networks that are also tie-strength related: Unscheduled meetings or IRC connecting all pairs, but particularly weakly tied pairs, and email networks connecting strongly tied work or social pairs.

Figures 1 and 2 also show how the media-based networks developed in two classes for which longitudinal data were collected. Over time, there were changes in media use, and differences between the classes, according to what media were mandated for class work (IRC, Webboard), and which were more private and optional (email, phone). In F97, IRC and email use start off fairly similarly. But this changes quickly as project groups form, and email use becomes focused for communication with fellow project members. F98 used rotating pairs to present in class rather than project



[a]Data are symmetrized, n=27 (25 respondents)

FIGURE 3 Overall work and overall socializing in Cerise

groups; and thus, their structures do not crystallize into the kinds of patterns shown in F97. Webboard use (not shown in the figures) also differed between the two classes. In F97, where use was mandatory, communication connected all-with-all for nearly the whole semester. In F98, Webboard use was abandoned early in the semester, and patterns show that very few people used it after it was no longer officially required for class (for the network diagrams and for more on the differences between the classes, see Haythornthwaite

2002a). Thus, mandated use, established by an authority beyond the group members (the instructor), greatly influenced communication patterns. It affected both who communicated more with others (e.g. because of group assignments), and what media were used for communications (e.g. the Webboards).

Interview data give a bit more insight into these media use patterns. Students reported that email was used in a near-synchronous manner at certain times of the week to chat with friends. This kind of interaction was possible because the submission of assignments led them to be online at the same time. While there, they took advantage of the opportunity to check for friends online. Interviews also revealed that IRC's whisper facility was used heavily between friends during classes. Although the data collected addressed IRC use in general, the interviews suggest a hidden strong-tie network is embedded in that data connecting subsets of whispering class friends.

Implications for mediated connectivity

These findings have a number of implications for the impact of media on group connectivity, and the wider sphere of Internet connectivity. The first section below addresses how the offline/online distinction in ties, and debates about whether one is more 'real' than the other, should be discarded in favor of adding media use to characteristics that indicate tie strength. The second section describes how the presence of a medium can provide a subthreshold level of *latent tie* connectivity on which weak and later strong ties may grow. The section also discusses how removing a medium can be expected to have different impacts on networks of weak and strong ties. The third section explores how the observed tiers of media use can be expected to carry different kinds of information because of their primary use for weak or strong tie relations. Across the sections, the importance of decisions made at the organizational or administrative level about what media to provide and promote is highlighted. The paper concludes with a discussion of specific implications for Internet effects.

Are online ties 'real' ties?

These combinations of network studies and interviews help address a question that is often asked about online interactions: Are online ties as 'real' as offline ties? From LEEP it looks like they are: online-only ties are characterized by the same kinds of interactions the literature tells us are found for offline ties. Friends (those who reported the tie as with a 'Friend' or 'Close Friend')

communicate more frequently, about more different things, and via more media than Non-Friends (those they 'work with only' or someone who is just a 'member of the class'). Online friends also include more socializing and emotional support in their communications than Non-Friends. Interviewees report deeply held friendships, as well as working relationships, with other LEEP students even though the relationships are maintained online with only occasional face-to-face meetings. Other studies of LEEP also reveal that many of the attributes of offline communities adhere, including bonding to the group as a whole, and development of common history and folklore (Haythornthwaite *et al.* 2000; Hearne & Nielsen 2004). Overall we find that, when asked, online participants themselves report strongly held, close ties with others that are as important to them as any offline tie.

These results and overall patterns suggest that we can add media use to the list of tie strength characteristics (see Table 2), as well as considering expectations about what kinds of media use are associated with both strong and weak ties (see Table 3). The expectations are derived from the two patterns of media use that have emerged from these studies: one pattern of wide connectivity with low frequency of communication, supported through opportunistic structures – hallway encounters arising from physical co-location, and in-class encounters due to joint attendance; and a second pattern of selective connectivity with those in close work or social ties, characterized by higher frequency of communication and use of person-to-person, private, and optional means of communication. In Cerise, the physical co-location and mandated meeting structures (for classes, research projects) created wide

TABLE 2 Media use associated with the strength of ties

weak ties	*strong ties*
Use few means of communication	Use multiple means of communication
Opportunistic: taking advantage of passive opportunities to interact, e.g. hallway encounters, class sessions	Proactive: seeking out means of contact, adapting media to joint use
Use organizationally established media only	Use organizationally established media as a base on which they add use of other media
Communicate infrequently via the one to two media they use	Use private, person-to-person communication
	Use email very frequently
whole weak tie network support	*whole strong tie network support*
Weak tie networks are created and sustained via the mandated, organization or group-wide media	Strong tie networks are supported through both mandated media and other optional, more private, means of communication

TABLE 3 Expectations for communication and media use by tie strength

weak ties	*strong ties*
Passive in contact with others	Adapt existing media and modify new media according to local norms (reinvention: Rice & Rogers 1980)
Wait for feedback via one medium rather than branching out to another medium	Locally established rules of behavior (adaptive structuration: Poole & DeSanctis 1990)
adoption of new media	*adoption of new media*
Slow to begin to use new media; weakly tied pairs do not add new media to their repertoire	Spread to new media as they appear and as they fit the tasks or exchanges at hand (adoption of innovations: Rogers 1995)
social influence among weak ties	*social influence among strong ties*
Low social influence on each other in use of media	High social influence among strongly tied pairs (e.g. Yates *et al.* 1999)

connectivity through face-to-face means, with closer work and friend pairs adding email and other media to this repertoire. In LEEP, wide connectivity was supported through the class-mandated media (IRC and/or Webboard) with email, phone, and IRC whispering added by closely tied pairs.

Latent tie theory

This use of media has further implications for the impact of the addition and/or subtraction of a medium from a group or organization's repertoire, leading to a theory I have proposed about the role of media in social networks. This theory helps reconcile conflicting views of the integrative or disintegrative impacts of new media (Haythornthwaite 2002a). Building on the finding that mandated media provide a substrate of connection for weakly tied pairs, the theory proposes that introducing a new medium to a group (1) creates *latent ties*, (2) recasts *weak ties* – both forging new ones *and* disrupting existing associations – and (3) has minimal impact on *strong ties*. For simplicity, the theory will be referred to as *latent tie theory*.

Latent ties

Adding any network-based means of communication – whether a new IRC channel, a social support group, a Webboard or email listserv – lays the groundwork for connectivity between formerly unconnected others.

Similarly, laying an infrastructure,[2] such as the Internet, intranets, wireless connectivity, grid computing, telephone lines, cellular service, community networking initiatives (Gurstein 2000; Keeble & Loader 2001), or neighborhood networks (Hampton & Wellman 2002), when combined with the devices that access them (phones, cell phones, computers, etc.) makes it possible for social networks to form. Such infrastructures make a connection available technically, even if not yet activated socially. These technical connections support *latent social network ties*, used here to indicate ties that are *technically possible but not yet activated socially*. They are only activated, i.e. converted from latent to weak, by some sort of social interaction between members, e.g. by telephoning someone, attending a group-wide meeting, reading and contributing to a Webboard, emailing others, etc.

Because such connectivity – by definition – brings together unconnected others, the latent tie structure has to be established by an authority beyond the individuals affected. Internet-based social support sites fit this profile. These are started by individuals with a particular interest in a subject (e.g. rare or chronic medical conditions) who may begin by posting information and providing the means for online discussion. Similarly, academic groups start listservs which provide a means for connecting like-minded individuals. The infrastructure of search engines that scan and index sites provides a way for individuals to find such sites and turn the sites into vibrant communities. Usenet discussion groups are a prime example of bringing people together socially through a technical infrastructure (e.g. Baym 2000; Kendall 2002). Older media also created latent tie networks. Thus, the telephone, particularly when aided by a directory, also lays technical connectivity that individuals can use to connect with others.[3]

Media and weak ties

When a new medium is introduced that connects disparate others, it has the potential to create weak ties by initiating social contact between otherwise unconnected others. This can be the case when an electronic discussion is established for help giving, or a web environment is created for interest-based discussion. The LEEP infrastructure creates an environment that – potentially – connects all current distance students. Joining classes and using IRC initiates weak tie structures as students talk and work together. Thus, one impact of a new medium, or new communication practices, is to *forge* new connections where these did not exist before.

By contrast, consider the potential loss of weak tie connectivity if IRC were suddenly removed from LEEP class use, or Cerise became geographically distributed and face-to-face meetings were no longer available. Such impacts may also be felt in an organization if the membership of email lists is changed, if email is used to decrease the frequency of face-to-face meetings,

or if costs are reduced by giving up office space and moving people to teleworkers positions instead. Each of these kinds of changes can be expected to have a *disruptive* effect on weak ties. Since weakly tied pairs have no vested interest in putting effort into continued contact, their association can be expected to disappear. Online groups may be particularly affected by such changes: LEEP students report that it takes 'more effort' to make and sustain relationships online, and to 'remain visible' in the online environment (Haythornthwaite *et al.* 2000; Bregman and Haythornthwaite 2003). Thus, a second impact of changes in media is to remove weak tie connections.

Media and strong ties

Strong ties, however, will be much less affected. If there is a change in a group-wide medium, those who are strongly tied, because they maintain their tie through several media and because they are motivated to continue communicating, can carry on through other media. Moreover, because of their influence on each other, they can jointly structure the use of a new medium to be more useful for the tie, finding ways to compensate for the loss of any other particular means of communication (as well as resist its use if it does not suit their needs, as in a group described by Yates *et al.* [1999], which resisted a change from face-to-face meeting to electronic contact). Finally, because of their need to communicate, strong ties are also more likely to adopt an extra medium if it is useful for maintaining relations important to the tie.[4] Whatever the media change, the strong tie network, unlike the weak tie network, is likely to remain intact.

Media use and information flow

There are further implications from the arrangement of ties and media use. Combining what we know about the types of information available from strong and weak ties with the results found in the studies on the use of media suggests that we may find significant differences in the kinds of information circulating through different media. New information, typically expected to be received from those with whom we are weakly tied, is likely to reach us through the group-wide media. Information from strong ties may come through this medium, but is more likely to be asked for and received via more private channels. Indeed, LEEP students report using the more private 'whisper' facility of IRC to ask in-class friends to explain concepts they do not understand.

In both work and learning environments, exposure to new ideas and opinions is cited as important for innovative and collaborative activity (e.g. Bruffee 1993). However, both types of groups also need to complete work

tasks such as making decisions, completing projects, producing reports, etc. Thus, we find two ongoing demands for information in working groups that we can expect to be satisfied through two different tiers of media: new information – the strength of weak ties – received via widely used, mandated, public media; and information or help in task completion for those working together – the strength of strong ties – given and received via person-to-person, optional, private media (for more on this, see Haythornthwaite 2002b).

Since groups do not suddenly appear fully formed, the preceding conditions have implications for technical and social interventions as groups begin.[5] Groups operate in cycles, coming together, forming work and learning associations, building trust, and completing work (McGrath 1984, 1990). Organizationally established, group-wide means of contact are needed to create latent tie connectivity from which stronger ties can grow. Such growth is unlikely to happen quickly with a technical connection alone; social interventions are necessary to support the creation of weak ties, e.g. by adding a social requirement to post to a Webboard, or to read and respond to email. However, contact that is only group-wide is unlikely to provide the safe space for discussion that lets pairs create a stronger tie. Groups need technical means for both public and private conversation, as well as opportunities to be together in ways that allow the social and emotional interactions that build strong ties. Such interventions are particularly important for time-limited, online groups that have particular difficulty with strong tie creation (Walther 1995; Haythornthwaite *et al.* 2000).

Organizational, administrative, or governmental choices will be highly influential in establishing not only what medium connects weak ties, but also whether latent and weak ties can grow stronger. Since new ties are most probably initiated and sustained via organizationally established means of communication, organizational level interventions, mandates and support for use, will determine what medium holds together the weak tie network. Once that weak tie network is in place, the medium also holds the means of sustaining it *and* of dissolving it: changes in both technical support for the medium and communication practices regarding its use have the potential to dissolve an existing weak tie network. For ties to persist, they need a broad base: maintenance via multiple media, including private channels through which stronger ties can be built. Organizational decisions play an important role in providing these added means of communication.

Internet connectivity

These findings about social network ties and media use, and the implications they raise, have important implications for the role of the Internet. The power of the Internet lies in the way it forges connections between people

where none existed, and thus in how it builds new weak tie networks. This power has been exhibited recently in cases of online activism, e.g. in support of the Zapatista movement in Mexico (Cleaver 1999), and the World Trade Organization protests (N30 Global Day of Action 1999; see also Ronfeldt & Arquilla 2001; Rheingold 2003), as well as grassroots, Internet-based initiatives in the US associated with Howard Dean's campaign for the Democratic party presidential candidate nomination (e.g. Weiss 2003; Hauben 2004). On smaller scales, local geo-communities may be influenced and take shape from the background exposure to web-based community network initiatives as this creates connectivity across the community as a whole (Lastra 2001). It is not new to suggest that the Internet connects people: Culnan & Markus (1987) pointed out that computer-mediated communication networks could create communities based on interest 'rather than by geography, social position, and prior acquaintance' (p. 34). More recent recognition of this impact worldwide, and particularly in response to the spread of wireless connectivity and peer-to-peer networking is well described by Howard Rheingold (2003) and his identification of Smart Mobs.

What is new is connecting this worldwide impact to the effects at the social network level, describing the social mechanisms that combine with the technical to create these waves of change. Considering tie strengths gives insight into what may be tipping latent ties into weak ones (or vice versa), and weak ones into strong ties. Moreover, it draws our attention to how social networks are constructed by the implementation and installation of computer network connectivity, and how we can intervene to make distributed groups work and learn better together, rather than sitting back and watching the phenomenon take us over. Much attention is now given to how to build strong enough ties between strangers so that they will engage in online commerce. Most well known is the reputation system for eBay that gives feedback on success of buyer–seller transactions for online auctions. The development of trust, an attribute of strong ties – in the buyer, the seller, and in the business or community supporting such transactions – is of particular interest to commercial providers, but is also relevant for the provision of many types of public information online, such as health information.

While the Internet and its media opens new lines of communication, it also structures who talks to whom. And, like other new infrastructures before it, the more 'traffic' flows on the Internet, the more those without the means to access it are excluded from its information. The Internet and the communications it carries can be seen to have impacts in the same manner as earlier transportation mechanisms and their traffic: railways and trains, highways and cars, air routes and airplanes. Each of these connects one hub to another, one person to another, one city to another, and their use has changed how people travel and where they can travel: new access

roads to major highways increase traffic on those highways, new air routes increase travel to those sites, and overall we travel more. What is significant here is not just that the Internet (or older means of transportation) opens new routes, but that use of such routes changes and enhances relationships in different ways according to the strength and/or commitment existing between communicators. Removing a means of communication between people precipitates the need for action to re-establish the tie via another means, an action that is not likely to be taken to reconnect a weak tie. When we move away from our familiar geographic location, we have to take action to replace face-to-face contact with phone, letter, or email contact in order to continue to maintain the tie. However, we may decide to let ties lapse because that switch requires effort above the threshold of activity normally used to maintain the relationship.

Even more profound changes are likely to occur to weak tie networks when media changes are decided at an organizational or governmental level. Discontinuing a listserv may remove all connectivity between those who only connected via this one forum or medium; changing from paper to web-based information dissemination (as many government offices are doing) changes where and when information can be received, and who has immediate, at-home access to such information. Switching media may also have impacts on social networks because of the type of relations the media helped maintain. Discontinuing a regular face-to-face meeting in favor of email or listserv discussion may remove the opportunities for social communications that held some weak ties together. By reducing the strength of already weak ties, their chances of surviving any further change may be greatly reduced.

The Internet is a technical means of connecting people. It provides an easy way for individuals as well as groups and organizations to adopt peer-to-peer communication. Weak ties can emerge based on interest, common need, or commercial enterprise, such as scholarly networks among academics; social and medical support groups (Bennett *et al.* 2002; Alexander *et al.* 2003; Hagar 2004); Usenet discussion groups (Baym 2000; Smith 2001); online universities, courses, and degree programs; and the activist groups noted above. We have also seen how weak ties can grow into stronger ties, e.g. in virtual communities, and via community networks (e.g., Baym 2000; Cohill & Kavanaugh 2000). Such pairs add new connections: meeting face to face where feasible, meeting synchronously online, adding private email to public discussion. Growth of ties should not be considered in terms of moving offline from online. Instead they should be considered as going from public to private via whatever means support that interaction.

In all the proactive building of strong ties from latent ties, we can also see that latent ties make connections that can be used by others. Our ties may be *hijacked*, as viruses use our email address books to spread further; they can be

borrowed or *mined*, as new applications search online address books to find business contact networks (e.g. Visible Path; Spoke software; Bulkeley & Wong 2003); and they can be *severed*, as viruses bring down systems, organizations change active pathways and separate connectivity among internal systems or realign access permissions, or a change in job loses us our social network as well as our business network.

Summary

Asking about media use in terms of who is talking to whom has highlighted that the strength of the tie matters in understanding what media connect who, and how this affects connectivity among existing and new group members. The implications of media multiplexity, i.e. that pairs use more media to communicate the stronger their tie, and that media used within a group conform to a unidimensional scale, reveal that different kinds of pairs, and different kinds of information flow, will be supported by public, organizationally established media, than by more private means. Organizationally established means of communication can lay the groundwork for latent and weak tie connectivity, and a base on which strong ties can grow. As organizational operations and government information become more entwined with Internet access, it is important to be aware of how such changes affect individuals' access to resources, and to contacts that can help them understand those resources. Internet impacts are not singular, but differ by the nature of existing relations. Such impacts have important implications for planning and policy relating to choices regarding communication structures and information dissemination, and future uses of the Internet.

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Notes

1 Cerise comprised 35 members of whom 25 responded. In the network diagrams below, 27 individuals are shown. Data were interpolated for two non-respondents who figured prominently in respondents' networks.

2 More layers of infrastructure can also be teased out: the technical wires and satellite connections on which phones, the Internet, and wireless devices run; the switching mechanisms and software that makes technical connections possible; an informational layer, e.g. building websites that advertise a common interest from which discussion can take place, or the creation of a listserv repository; and last the social layer where interactions and conversations happen and create ties between people.

3 Thanks to Ben Anderson for noting the connection to the telephone.

4 There is an important difference here between an individual adopting a new medium, and a strongly tied pair adopting its use. Adoption rates appear to be 100 per cent when each individual uses the medium with one other person, but the network level adoption may be sparse.

5 See Bregman & Haythornthwaite (2003) for discussion of factors that inhibit new users in online environments.

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