Media Use in a Global Corporation:
Electronic Mail and Organizational Knowledge

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Abstract

How has the proliferation of communications media changed the volume of communication and the distribution of information in large organizations? There is reason to think that the availability of more communication media increases the amount of communication employees receive, with positive effects on their organizational knowledge and commitment, but negative effects on their perception of being overloaded. Prior research suggests that electronic mail may differ from other media by more effectively spreading organizational information to peripheral employees, and doing so while interrupting them less than other styles of communication. This paper uses survey data from a large US-based multi-national corporation to examine the effects of communication by electronic mail and other media. Results are that employees who used electronic mail extensively, net of their communication over other media, were better informed about their company and more committed to its management's goals. One reason for their superior organizational knowledge seems to be that electronic mail promotes "<u>information spillover</u>" from a focal recipient of a message to others who are less directly interested in a message, but does so without subjecting the marginal parties to the burdens of interruption and information overload.

Introduction

Over the last fifteen years there has been a proliferation of communications media available to employees in large corporations. Facsimile (fax), electronic mail, and video-conferencing now supplement traditional media such as face-to-face meetings, postal mail and the telephone. What are the effects of this rich mix of communication media? While organizations generally introduce new information technology to improve effectiveness or productivity, the results are not always straightforward or beneficial at the individual or organizational levels (Attewell, 1994; Landauer, 1995; Sproull & Kiesler, 1991).

Does the rich mix of communication media available in many organizations result in more communication, with the result that organizational participants are better informed, or do they simply experience more interruption and information overload? Are far-flung parts of multi-national organizations better integrated into the firm because of the new media, or does the communication enhance local communication and benefit primarily those who already at the center of the organization?

While our interests in this article are to understand the impact of the new media, in order to do so we must also confront questions of media choice, if only for methodological reasons. To examine the effects of new media, one must control for their use by different people with different organizational roles and their use in different situations to accomplish different tasks .

These issues are addressed below through an analysis of survey data from a large US-based multi-national corporation which has one of the largest and oldest firm-wide electronic mail networks, as well as the full complement of other communications media (phone, fax, mail, video-conferencing). We begin with a review of pre-existing theories about media use and impacts that inform the design of our own study.

Media Impacts: Overload and Peripherality

There are many potential effects of the new mix of communications media. In this study, we focus on two that are of particular salience in corporate settings--the extent to which new communication media change the volume of communication in an organization and the extent to which they change the distribution of information.

Overload. A potential consequence of today's media-rich environment is that it increases the volume of communication within an organization initiate and receive. There is substantial evidence that the demand for communication is elastic. If one reduces the monetary costs of communication, by reducing its tariff, or the behavioral costs, by making it easier to accomplish, the amount of communication typically increases (Mayer, 1977; Zipf, 1949).

While for many purposes this increased volume is desirable, a potential negative outcome is that it might disrupt users' work lives. In general, communication is a resource-consuming process. It takes effort and attention to initiate and receive communication. As a result, one would expect that as the volume of communication increases, so will the problems of feeling rushed and overloaded. One reason that some employees work at home is that work at the office is often too hard to accomplish, at least in part because the volume of communication in the office is too intense and too interrupting (Gerson & Kraut, 1988).

Analytically one may distinguish two disruptive impacts of heavy communication: information overload (an increase in information received and/or requests for information) and communication intrusion (an increase in interruption of work by communications.) While all communications media may increase information overload, some communications media are clearly more intrusive than others. Synchronous media, such as telephones and face-to-face meetings, take place in real time—all parties have to be available at the same time. In contrast, asynchronous media, such as fax, electronic mail, and postal mail, communication takes place through staggered rounds and can be scheduled by both sender and recipient at times convenient to them. The asynchronous communication, as a result, is nowhere near as disruptive as a synchronous medium like the phone, where one has to stop what one is doing to answer it.

Since many of the new corporate communications media, like electronic mail, are asynchronous, we hypothesize that they can add information without adding commensurate intrusion. Yet is likely that the total volume of communication, irrespective of medium, will be associated with information overload.

A second and neglected issue concerning media disruption involves looking at individuals' separate roles as senders and receivers of messages. These differences in role also have implications for the degree to which communication media are disruptive. Generally, a communication episode involves one party who initiated it and another who is a recipient of it. These two roles are different in terms of goals, costs, and benefits. The initiator has a reason in mind for starting the communication and schedules it at a time that is convenient to him or herself. The recipient, on the other hand, may be thought of as a more or less

willing victim of the initiator's designs. From the recipient's perspective the communication is likely to arrive at a random time, often interrupting ongoing work. The communication is often a request for information or aid that will benefit the initiator, not the recipient. Thus initiators and recipients of communications are likely to experience the same communication very differently.

Our research examines the perceived value and costs of communication for each role, and documents the extent to which role differences vary by medium. We hypothesize that role differences would be reduced in asynchronous media such as electronic mail, fax, and voice mail, which enable receivers to schedule their receipt of messages.

Peripherality. The new communication media have the potential not just to increase the total volume of communication within an organization, but to increase it most for people who are at its periphery and thus relatively communication-deprived. Several authors have argued that electronic mail in particular has the capacity to increase the level of knowledge and degree of emotional involvement of people at the periphery of an organization--from night-shift workers to geographically-distant branches to low-status employees who might otherwise hesitate to speak up (Feldman, 1987; Hesse, Sproull, Kiesler & Walsh, 1993.) To understand why such outcomes are expected requires a brief overview of studies of space, knowledge, and organizational communication.

In large corporations, members learn much of the core technical knowledge they need to do their jobs and a substantial amount of incidental information by bumping into interesting people or situations, through incidental communication (Kusterer, 1978, Lave & Wenger, 1991.) Employees use unplanned encounters both to keep up with information about customers, technical developments, or company politics and to learn the often-unwritten rules of performance, such as the degree to which customer service is valued or the extent to which fudging is tolerated in expense vouchers.

Physical and geographical proximity of organizational members increase both informal communication and more official interactions (Allen, 1977; Conrath, 1973; Monge, Rothman, Eisenber, Miller & Kirste 1985.) Zipf (1949), Festinger, Schachter and Back (1950) and Allen (1977) have all documented that communication between individuals declines rapidly with distance. The volume of this communication is important, because much coordination, on-the-job training, socialization, and development of organizational culture occur through informal communication.

A company headquarters is often is the political and operational center of an organization. Compared to those who have offices at headquarters, employees who are geographically distant have fewer opportunities for communication with colleagues, for influencing and being influenced by them, and for observing them at work. Peripheral organizational members are therefore disadvantaged in knowing about their firm and its work environment (Hesses, Sproull, Kiesler & Walsh, 1993.) In national and international companies, with very large distances between sites, the difficulties of spontaneous contact for periphery employees are compounded by time-zone differences and transportation difficulties that make even intentional contact and attendance at headquarters' meetings difficult.

While being peripheral within an organization is partly a matter of geography, there are other more sociological dimensions of peripherality as well. Seniority, occupational status, placement in organizational networks, and even gender may affect peripherality, and hence may influence both communication and organizational knowledge.

Feldman (1987) and Hesse, Sproull, Kiesler & Walsh (1993) argue that electronic mail is particularly well-suited to reducing peripherality disadvantages in organizations. First, electronic mail has features like distribution lists and electronic bulletin boards that increase the number of people who will receive any particular communication. These mechanisms enable electronic mail users to bump into information and other organizational members serendipitously, just as physical proximity functions elsewhere. Second, Kiesler and Sproull (1986) argue that compared with other media, electronic mail reduces social context cues, so that one is less sensitive to the sender as a social presence. They argue that this reduces the peripherality deficits associated with low status or seniority, gender, and other personal attributes. Thus, they hypothesize that heavy use of electronic media, especially electronic mail, should compensate for both geographic and social peripherality in organizations.

However, there is an alternative view. Distance-reducing technologies are often used to supplement prior face-to-face communications. In addition, although these technologies are relatively insensitive to distance, people mostly use them to communicate with people who are geographically close by. (See Eveland & Bickson, 1987 for electronic mail and Mayer, 1977 for telephone.) The implications of these latter findings are that electronic media may not reduce differences between centrally-located versus peripherally-located individuals but may even exacerbate pre-existing inequalities in communication and knowledge within an organization.

A major goal of our research is to examine the extent to which differential use of various media is associated with improvement in organizational knowledge and

the extent to which the peripherality deficit is reduced, and to identify the characteristics of media that are associated with differences in organizational knowledge.

The Ecology of Organizational Comunication

To answer questions about the effects of new media, one must also control for their differential use across people and tasks. That is, in order to assess whether the new media mix causes information overload or whether the use of electronic mail makes people at the periphery of an organization better informed, one must examine and control for the reasons people differ in the amount they communicate and the media with which they choose to do so. We briefly discuss some important attributes of jobs, of communication media, and of their interaction that might influence the amount that people communicate and the effects of that communication.

Some work by its nature is interdependent and requires contact with customers or coordination with co-workers, and thus more communication. Management, for example, is primarily a coordination job, and Mintzberg (1973) noted over twenty years ago that communication is the central activity in managerial work. If indeed jobs vary in their communication intensity, then one would expect that people in communication-intensive jobs would heavily use all of the media available to them.

Jobs differ not just in the amount of communication they require, but the type of communication as well. Moreover, communication media may differ in the types of tasks for which they are most appropriate. *Media Richness* (Daft and Lengel, 1984 & 1986))and *Social Presence* (Short, Christie, & Williams, 1976) are two related theories that emphasize the fix between job characteristic and the amount and kinds of information that can be carried by different media, i.e., their *carrying capacity*. Both hypothesizes that people will choose to use richer media—i.e., media that are more like face-to-face communication—when they are faced with greater uncertainty, when they have more complex information to communicate, when they most persuade or when the social dynamics of their communication is important. information. Thus, people whose jobs are more social, ambiguous, or complex should habitually use richer media, that is, media that are more interactive and expressive.

The implication of media richness theory is that people will specialize in a type of communication. Mintzberg (1973), for example, argues that because managers have to deal with uncertainty continually, they have a strong preference for face-to-face communication. If there is competition among media, then one might

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expect people who send a lot of electronic mail to do less faxing, or that heavy telephone users would communicate less through face-to-face conversations. This specialization hypothesis can be contrasted with a synergy hypothesis, that heavy use of one medium would lead to heavy use of others. According to this thesis, media are to a degree interchangeable and may even supplement each other. For example, one might use fax to distribute documents before a face-to-face meeting, and then follow up the discussion with both telephone calls and electronic mail exchanges.

In testing for the effects of electronic mail and other communications media on employees' organizational knowledge, their perceptions of overload, and amount they are interrupted, we will attempt to control for job and media attributes that media richness theory and critical mass theory implicate as important in media choice.

Methods

Overview. We conducted a survey of both high- and low-volume electronic mail users in the United States and international locations of a large commercial bank in 1992. We selected this organization for study because it was a multinational corporation, which made problems of peripherality likely, and it had one of the oldest and largest corporate electronic mail networks in the world. At the time of the study, the company had about 100,000 employees in over 83 countries on five continents. At that time, its electronic mail network was almost ten years old and was used by over 26,000 employees spread across North America, Europe, Latin America, and Asia. The corporation spent approximately 14 million dollars per year in running and maintaining its electronic mail network.

The proprietary electronic mail package used by over 90% of employees who used any electronic mail system allowed them to send to and receive messages from other users of the company-sponsored network, but did not support gateways to external networks. That is, they could communicate only with people who had accounts on the corporate system. The electronic mail software provided a corporate-wide directory, commands for sending messages to individuals and locally created mailing lists, and a rudimentary news and clipping service. The system also had commands for looking up name, title, and location of individuals on the system, for saving messages to external files, and for up-loading formatted documents previously written on personal computers. Only system administrators were allowed to send messages to corporate-wide distribution lists (i.e., to everyone). They typically did so as agents for senior executives. The user interface to the electronic mail system consisted of typed commands and a cumbersome line-oriented editor for composing and modifying

messages. Users accessed the system by dialing in to the corporate telephone network.

Sample. Using lists provided by the bank, we drew a sample of 2,733 employees. Of these, 928 were a control sample of employees in the United States selected randomly from the corporate phone book, independently of whether they used electronic mail. The remainder was a stratified random sample of employees who had used an electronic mail account in 1991. Stratification was used to insure that respondents varied by geographic location and also varied in their heaviness of use of electronic mail. Of the stratified sample, 1,097 individuals were located at corporate headquarters, 261 were located in other parts of the United States, 254 were located in London, and 261 were located in Hong Kong. Among these employees approximately half were selected to be clustered around the 25th percentile and half around the 75th percentile of frequency of electronic mail usage (i.e., we sampled heavy and light users, but not the far extremes).

Of the questionnaires mailed out, 403 were returned as undeliverable. After sending a reminder postcard and a follow-up questionnaire, we received 973 completed questionnaires, which is an effective response rate of 42 percent.

Questionnaire and analyses: In order to examine media use, we constructed a multi-page questionnaire that probed employees' job attributes, demographic control variables, organizational knowledge, information overload, and media use. Most Cronbach alpha measures for multi-item scales were between .60 and .80, showing lower reliability than we would have liked, but sufficient for exploratory research.

Several job attributes related to communication intensity or that previous researchers had demonstrated to be associated with media choice were measured. To measure the uncertainty and equivocality associated with a job we adapted Van der Ven et al.'s (1976) measure of procedural work (the degree to which a job consisted of routine tasks) and Cammann et al.'s (1983) measure of work challenge (the degree to which job tapped a variety of skills). We also included more detailed measures of work process relevant to needs for richness and social presence in communication media, adopted from Bikson (1986) and Bikson and Markus (unpublished). Managerial work (the extent to which respondents managed people or handled emotional situations) and sales work (the extent to which a job required sales or persuasion) are equivocal and socially demanding, while text work (the extent to which respondents read and wrote), and quantitative work (the extent to which respondents worked with numbers and charts) are less so.

To measure the interdependence associated with a job, we adapted Van der Ven et al.'s (1976) measure of work interdependence (the extent to which a job required coordination among multiple parties). We also measured the interdependence of jobs in more detail: the number of employees supervised, working on task forces (the extent to which employees worked with temporary groups) and working with outsiders (the extent to which employees worked with people who were organizationally or geographically remote).

As control variables, we included the demographic variables of age (which was highly correlated with job seniority) and gender. We also included organizational level (from staff member to vice president) and several material conditions of work, such as working outside normal location or hours and having a secretary.

As outcome measures we were interested in respondents' organizational knowledge, their organizational commitment, and their experience of being overloaded. Our organizational knowledge scale consists of an eight-item multiple-choice test of facts about the company (e.g., .Whom did the corporation recently name as a vice chairman? How many employees is the corporation expecting to cut in 1991 and 1992? Cronbach's Alpha = .76) . The facts were taken from national newspaper articles in the six months prior to the distribution of the survey. The organizational commitment scale came from a survey that the company had conducted 12 months prior to our research, as part of its regular assessment of corporate morale. The latter focused on respondents' evaluation and agreement with senior management's strategic direction (e.g., I agree with the corporation's strategic direction and goals. Cronbach's Alpha = ..80).   From Cammann et al (1983) we derived a measure of overload (e.g., I frequently receive more information during the day than I can use; My work is frequently interrupted. Cronbach's Alpha = .76).

Our primary measure of peripherality was geographic, the distance between an employee's work location and corporate headquarters, coded in three steps (at corporate headquarters, in other areas of the United States, or abroad). Demographic and job characteristics such as age, gender and organizational level provided sociological measures of organizational peripherality.

The questionnaire probed each user's experience with several communication media, including face-to-face communication, telephone conversations, electronic mail, fax, voice mail, and overnight mail services. The questions included both aggregate and episode-specific items. In the aggregate items, respondents averaged their descriptions or estimates over many experiences. For example, they estimated the number of conversations or meetings they had per day and the number of electronic mail, voice mail, facsimile, voice mail,

overnight mail and telephone calls they sent and received during a typical week. Since these estimates were not normally distributed (there was a long tail of very-high volume communicators), they were converted to a log scale in the analyses that follow. To derive a measure of total communication, we converted these estimates to Z-scores and summed them. As a measure of media penetration, respondents also estimated what percentage of the people with whom they needed to communicate for work could be reached through each medium.

Although we asked questions about a variety of media, we focus our analyses on face-to-face, telephone, electronic mail, and facsimile communication. Empirically, these four represent the most frequently used communication modes in the bank. Theoretically, they vary in interactivity and expressiveness, the two dimensions of media richness (Kraut, et al., 1992). Face-to-face and phone communication are more interactive than fax and electronic mail. Face-to-face and fax communication are more expressive respectively than phone and electronic mail communication. Face-to-face communication provides physical context and facial expression missing in phone conversations; fax allows graphics, letterheads, formatting and signatures missing in the ASCII electronic mail available in this corporation.

Episode-specific questions asked respondents about their most recent communication episode in each of the four communication modalities. They indicated who initiated the episode and, on 3-point Likert scales, the extent to which the communication interrupted work, whether they kept a record of the communication, and the usefulness of the communication along three dimensions derived from McGrath (1984): a) product: getting work done, b) interpersonal: developing or sustaining a work relationship, and c) organizational maintenance: keeping up with organizational news, politics, or people. Even though each respondent described multiple communication events (one for each modality), in the analyses that follow we randomly selected one event for each respondent to control for the inflation in degrees of freedom.

Analyses using the episode-specific questions treated the media as differing on two dimensions: interactivity and expressiveness. Interactivity contrasts highly interactive media (face-to-face and phone communication) with minimally-interactive ones (fax and electronic mail communication). Expressiveness contrasts media that transmit more information with media that transmit less. We examined expressiveness within interactivity, through two single degree of freedom contrasts. The first contrast compared face-to-face communication with phone communication (both high interactivity, but the former being more expressive) and the second contrasted fax communication with electronic mail (both low interactivity, the former being more expressive.)

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Results

Media Use

Respondents reported having a large volume of communication. Over all media, respondents reported having an median of 265 conversations or messages per day, or more than 1 communication every 11 minutes. They estimated they spent 39% of their workday communicating. While Panko (1992) argues that self-report estimates are only moderately accurate, he notes that they tend to underestimate the total amount of communication, since respondents frequently discount brief or routine communication episodes. Regression analyses, not reported here in detail, show that people who do sales and persuasion work, whose work is interdependent with others, who work in task forces, who have challenging work, and who work outside of normal hours and location are all heavy communicators. Surprisingly, neither respondents' managerial level nor the number of employees they supervise predict the amount they communicate.

We found that at the aggregate level, people who communicate heavily in one modality tend to communicate heavily in others as well. That is, people do not seem to specialize in certain media at the expense of others. Table 1 shows the intercorrelations among measures of use of each medium. While the average correlation is weak, all are positive, and summing the amount of communication across the six modalities produces a communication intensity scale with a Cronbach's alpha of .51. These data contradict the media specialization hypothesis and are consistent with the media-synergy hypothesis discussed above.

Because we found that communication across media is intercorrelated, when creating regression models for electronic mail usage and various dependent variables in the analyses that follow, we hold constant the use of other media, by constructing a scale for the combined frequency of use of all other communication media.

TABLE ONE HERE

Total communication volume is partially explainable by job function and work characteristics. People whose work is interdependent or involves selling, working on task forces, working outside the conventional business schedule and

location (and therefore having greater coordination needs), and those who have more challenging work--all report higher rates of total communication.

Consequences of media use

Our hypotheses about the consequences of media use were that people who were peripheral to an organization would be disadvantaged in keeping up with relevant organizational information, and that they would feel less committed to the organization. However, because electronic mail has attributes that can help to overcome these deficits, those peripheral employees who were heavy users of electronic mail would be more informed and committed. Electronic mail, along with other non-interactive media, might provide this information without substantially increasing overload.

Tables 2 through 4 show regressions predicting scores on the organizational knowledge scale, the organizational commitment scale, and the overload scale. For each dependent variable, we conducted three analyses: 1) a basic analysis in which the predictors are geographic peripherality and control variables measuring demographics, jobs, and total communication volume,; 2) an analysis that added electronic mail use to this equation; and 3) an analysis that also added electronic mail by peripherality interactions. The entries are standardized beta coefficients for those variables significant at least the .05 level.

Organizational knowledge. The data are consistent with the thesis that peripheral employees are less informed about their company than non-peripheral members. Table 3 the first column shows that women know less than men, those at lower managerial levels know less than those at higher managerial levels, and those who work in Asia, Europe, or non-headquarters sites in the United States know less than those located at corporate headquarters.

The data also show that heavier users of electronic mail know more about the organization than lighter electronic mail users, holding other variables constant (see Table 3, column 2). Moreover, extensive use of other communication media was not associated with increased organizational knowledge. As previous researchers have suggested, there does seem to be something distinctive about electronic mail in facilitating organizational knowledge.

Finally, we tested the prediction that the use of electronic mail would especially alleviate the deficits in knowledge associated with geographic and other peripherality. Statistically this was done by including a peripherality by electronic mail interaction term in the regression for which organizational knowledge was the dependent variable. The last column of table 3 reports the

interaction for geographical peripherality. Other analyses not reported here show similar results for social peripherality. In all cases, the interactions were not statistically significant. In this corporation, electronic mail does not differentially advantage peripheral employees, in terms of organizational knowledge.

One mechanism through which heavy use of electronic mail could enhance organizational knowledge is a communication spill-over effect. In using electronic mail, it is easy to add additional readers through a copy or "cc" command and to electronically copy and forward documents or messages. This means that information addressed to one person is often routed to others who were marginal to the original conversation and who had expressed no direct interest in being party to it. Routine audits of the electronic mail traffic at this corporation show that a typical electronic mail message has three or four recipients. Examining the ratio of messages received to messages sent in our sample suggests that people receive considerably more messages by electronic mail than they send out: a ratio of 2.7 incoming electronic mail messages for every outgoing one. This contrasts with the use of other media, where the ratio of messages received to sent is closer to 1:1. (For fax the received to sent ratio is 1.2:1, and for telephone calls it is 1:1.) This distinctive characteristic of electronic mail means that through electronic mail people can bump into information that they had not intended to see, much as physical proximity can put them into unintended face-to-face contact with other people.

The use of electronic bulletin boards or clipping services would be a more direct mechanism for electronic communication to lead to organizational knowledge. However, it does not seem to explain the link at this corporation. While typically people who use electronic mail are also likely to subscribe to corporate electronic bulletin board services, in this corporation these services were used infrequently. In the six months prior to the survey, only 26% of the sample had used them, and these respondents used the services less than once per month. Thus, the use of bulletin board services is unlikely to account for the observed association of electronic mail use with organizational knowledge.

Organizational commitment. Contrary to our expectations, geographic and social peripherality did not affect levels of organizational commitment, defined as approval of the company's strategic direction and trust in its leadership. Both people who had routine work and those who had challenging jobs in this firm were more committed to senior managers' plans, while those who worked alone were less committed. (See Table 4).

However, heavier use of electronic mail, controlling for other factors, was associated with higher levels of organizational commitment. This was not true of other media: those who had heavy communication volume through other media

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were less committed. Thus, in addition to increasing employees' knowledge of the firm, electronic mail appears to increase employee commitment to top management's strategic direction, holding other pertinent variables (such as level in the firm) constant.

Again, none of the peripherality by electronic mail use interactions approached significance. Electronic mail did not affect peripheral members' sense of commitment any differently than that of non-peripheral employees.

TABLE THREE HERE

Overload & interruptions. Employees who communicated more (across all media combined) indicated greater problems with information overload, interruptions, and feeling rushed. High volumes of communication do exact a cost. However, consistent with our expectations, even though electronic mail increased the amount of information employees receive, it does not increase their psychological experience of being overloaded, rushed, and interrupted, over and above their volume of communication by other media. (See Table 4)

TABLE FOUR HERE

We anticipated that electronic mail would relatively non-intrusive because it is asynchronous, and therefore doesn't interrupt normal work flow. One can read and respond to electronic mail at one's own convenience. We confirmed this explanation in the part of our questionnaire that asked respondents to rate their most recent communications for each medium. Figure 1 plots responses to the question, "How much did this communication interrupt your work?" by medium and communication role (initiators or recipient). A communicator role X interactivity X expressiveness analyses of variance shows that synchronous media are substantially more intrusive than asynchronous media. ($F_{(1, 824)}$= 83.8; $p < .001$), and that recipients of communication are interrupted more than initiators ($F_{(1,824)} = 6.62$; $p < .01$). The significant interactivity X role interaction shows that the difference between recipients and initiators occurred only for the two synchronous media. Among the synchronous media, telephone and face-to-face communication were not significantly different in terms of work disruption, and among the asynchronous media, electronic mail and fax did not differ.

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FIGURE ONE HERE

Communications value. We earlier found that people received more messages by electronic mail than they sent. Our evidence also shows that compared to other media, electronic mail messages were perceived to be especially valuable for keeping up with organizational information (as opposed to getting focal tasks done or maintaining personal relationships). Respondents evaluated a recent communication episode on three dimensions: getting work done, maintaining a work relationship, and keeping up with corporate information. Figure 2 plots these results.

FIGURE TWO HERE

Analysis of variance shows that for accomplishing work and for maintaining relationships, initiators perceived the communications to be more valuable than did recipients, and that for all three dependent variables synchronous communication was perceived as more valuable than asynchronous media. However, electronic mail was judged to be especially useful for keeping up with company news, personalities and gossip. For this purpose, electronic mail was rated as positively as face-to-face communication and significantly better than fax ($F (1,810) = 7.35$, $p < .01$).

Recording communication. Finally, the communication episode data show that people were more likely to keep records of asynchronous communication (about 63% of messages) than synchronous communication (about 38% of conversations), presumably because electronic mail and fax were already in a recorded form ($F (1,813) = 29.7$, $p < .001$). Although respondents reported to be slightly more likely to keep records of fax communication (70%) than of electronic mail (64%) this difference was not statistically reliable ($F (1,813) = .13$; $p > .50$). In field work in the corporation we were struck by the extent to which both electronic mail and fax had been absorbed into normal bureaucratic record-keeping. Many employees printed and filed copies of all electronic messages they received. Others archived messages selectively on disk.

Discussion

This research was intended to explore the consequences of a rich multi-media environment typical in today's corporations.

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Our first finding was that even though individuals do choose between media for specific messages, they don't specialize in terms of their communication in the aggregate. People whose jobs require substantial communication communicate heavily across all the media available to them. They do not seem to favor one channel over another, such as being a phone user rather than an electronic mail user. In this firm, the heaviest communicators tended to be people in temporary teams or in work-groups, and people whose work involves persuasion or sales. In theoretical terms, the multiple communications media in this organization appear to be in a synergistic or additive relationship rather than being competitive.

We found that electronic mail was distinctive in several respects. Employees who used electronic mail extensively, net of their use of other media, were better informed about their company and were more committed to management's goals. This finding remained significant after factoring out potential confounding issues such as users' status within the firm, kind of work, and so on.

One reason for electronic mail users' superior organizational knowledge may be that electronic mail promotes information spillover from a focal or intended recipient to other parties not directly involved in a message. Electronic mail, compared to other media, requires little effort to add multiple recipients to a message, to send messages to distribution lists, or to capture electronic messages for resending. Our data suggest that electronic mail is the only medium in which the ratio of messages received to messages sent is so large. This suggests that the spillover effect is stronger for electronic mail than for other media.

This spillover phenomenon has been dramatically illustrated in several recent episodes in large corporations in which privileged information spread through out the corporation via electronic mail. Our findings suggest that electronic mail doesn't just broadcast organizational gossip; it also informs large numbers of employees about important company events, and that this informative function is associated with greater commitment and understanding of company strategy. Given the centrifugal tendencies in any large organization, this aspect of electronic mail is likely to be welcomed.

Several researchers have reported that electronic mail is particularly advantageous for peripheral members of an organization, that it can help night-shift workers feel more involved or increase the effectiveness of low status individuals. While we found that peripheral employees were indeed less knowledgeable than others, and that electronic mail increases knowledge, we did not find evidence that peripheral employees are especially aided by electronic mail use or by other communications media. The use of electronic mail benefits

central and peripheral employees equally. We were unable to support the peripherality thesis.

Finally, we studied the disruptive effects of communications media, including both information overload and interruptions from media. Respondents' reports of disruption of work are associated with heavier communications levels. However, the problem appears more severe with face-to-face and telephone communications than with the newer asynchronous media. Electronic mail and fax are less likely to disrupt work because the receiver has more control over answering and replying. Thus the proliferation of these newer asynchronous media is unlikely to provide the straw that breaks the camel's back.

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List of Tables and Figures

Tables

	Electronic mail	Facsimile	Voice mail	Overnight mail	Phone calls
Facsimile	.177	1.000			
Voice mail	.006	.164	1.000		
Overnight mail	.120	.488	.103	1.000	
Phone calls	.195	.340	.218	.211	1.000
Face-to-face	.064	.067	.037	.113	.079

Table 1: Correlations among use of different communication media

Note: Ns range from 757 to 794. Correlations were based on the log of the number of communications per week in each media. Correlations greater than .064 are significant at least at the .05 level.

Variable	Control variables	Control + Electronic mail	Control + Electronic mail + Interactions
Gender (Male)	.15	.15	.15
Management level	.20	.19	.19
Have a secretary	.10	NS	.10
Do managerial work	-.08	-.09	-.09
Do quantitative/graphics work	.08	.10	.10
Work interdependence	NS	NS	NS
Work with customers & distant others	.08	.08	.08
Work outside normal hours & location	NS	NS	-.04
Work is procedural	NS	NS	NS
Geographic peripherality	-.15	-.17	-.16
Use of other communication media	NS	NS	NS
Use of electronic mail		.14	.13
Electronic mail X peripherality			NS
Adjusted R squared	.137	.150	.150

Table 2: Predicting organizational knowledge from electronic mail use and control variables.
Note: Entries are standardized beta weights significant at least at the .05 level.
N = 683

Variable	Control variables	Control + Electronic mail	Control + Electronic mail + Interactions
Management level	NS	NS	NS
Do managerial work	NS	NS	NS
Have a secretary	.08	NS	NS
Do text/analysis work	NS	-.08	-.07
Do quantitative/graphics work	NS	NS	NS
Work interdependence	.10	.09	.09
Work with customers & distant others	NS	NS	NS
Work outside normal hours & location	NS	NS	-NS
Work is procedural	.20	.21	.21
Work is challenging	.14	.14	.14
Geographic peripherality	NS	NS	NS
Use of other communication media	NS	-.08	-.08
Use of electronic mail		.10	.10
Electronic mail X peripherality			-.01
Adjusted R squared	.072	.078	.078

Table 3: Predicting organizational commitment from electronic mail use and control variables.
Note : Entries are standardized beta weights significant at least at the .05 level.
N = 748.

Variable	Control variables	Control + Electronic mail	Control + Electronic mail + Interactions
Management level	NS	NS	NS
Do managerial work	.14	.14	.14
Do text/analysis work	.17	.16	.16
Do quantitative/graphics work	NS	NS	NS
Work interdependence	NS	NS	NS
Work with customers & distant others	NS	NS	NS
Work outside normal hours & location	NS	NS	NS
Work with task forces	NS	NS	NS
Work is procedural	-.07	-.07	-.07
Work is challenging	.16	.16	.16
Geographic peripherality	NS	NS	NS
Use of other communication media	.16	.16	.16
Use of electronic mail		NS	NS
Electronic mail X peripherality			NS
Adjusted R squared			

Table 4: Predicting overload from electronic mail use and control variables.
Note: Entries are standardized beta weights significant at least at the .05 level.
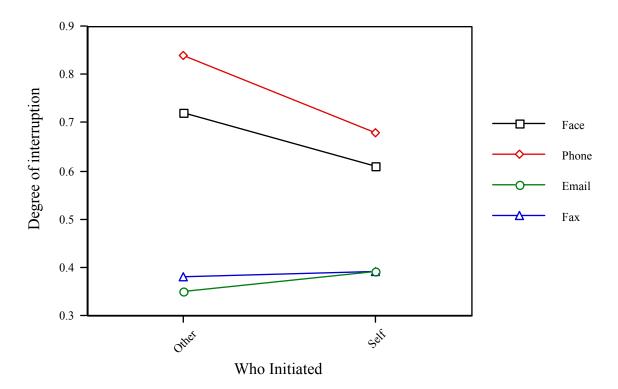N = 759.

Figures

Figure 1: How much did a communication episode interrupt work, by modality and communication role.
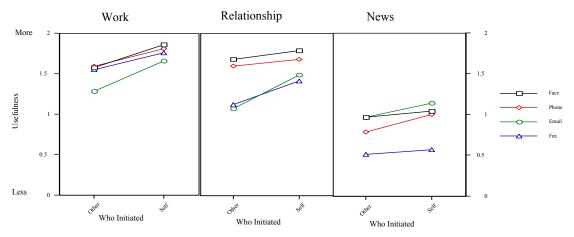
Figure 2: How valuable was a communication episode for different activities, by modality and communication role. Activities include getting work accomplished, maintaining work relationships, and keeping up with company information.