THE EFFECTS OF COMPUTER-MEDIATED COMMUNICATION SYSTEMS ON WRITING

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Abstract

Computers are changing the way we communicate. Examples of new communication patterns abound, supported by various--often conflicting--theories. This paper examines how electronic mail, in particular, may be changing the way we write. Included is discussion of an original study which sought to clarify some of the conflicting theories. The literature review and the results of the study, although tentative, provide a research agenda and useful findings for application to organizations.

INTRODUCTION

The emergence of the computer as a communications device is changing how people communicate. In 1984, 100 million messages were sent via electronic mail [Fersko-Weiss, 1985]; by 1988, users are expected to number five million [Cooper, 1985]. Omni Group Ltd. estimated that 71 percent of the Fortune 1000 companies would have long distance messaging in 1986 compared to 62 percent in 1985 [Kolodziej, 1985]. By 1990, the "E-mail" market should reach \$4.3 billion [Fuerst, 1985].

Before the computer became a communication tool, written communication was limited to inflexible, mechanical means. Delivery was slow and often unreliable. For interaction to be successful, the receiver had to be at a pre-specified location.

Writing is now infinitely malleable. With text editors, corrections and revisions can be performed quickly and easily [Suplee, 1984, p. 250]. Communication has become asynchronous as well. With the proper equipment, communicators are no longer restricted by time or location.

With these technological advances,

a fundamental question has emerged: "How has computer technology affected the way people communicate?" In the present study, another, more specific question is also addressed: "What are the effects of computer-mediated communication systems on writing?"

PURPOSE OF THIS REPORT

The purpose of this paper is three-fold: (1) to focus attention on the effects of computer-mediated communication systems on writing; (2) to provide a background on some of the previous work in this area; and (3) to conduct exploratory research on the topic.

A number of issues are raised in the paper, including how computers may influence the content, tone, personality, length, frequency, mechanical soundness, effectiveness and efficiency of our written communications.

LITERATURE REVIEW

Electronic messaging systems range from telephone message recorders to advanced voice digitizing systems [Beagley, 1984], and may take several forms: a notepad, electronic mail,

computer conferences, bulletin boards, and electronic journals [Losey, 1985]. Electronic mail typically refers to three devices used for the transmission of data: facsimiles, teleprinters, and computer-based systems [Ichard, 1985].

Advantages of Electronic Mail

Electronic message systems differ from more conventional communication systems, such as traditional mail service, in that they are more concerned with the transmission of intelligence between people, rather than with the transmission of information from one physical location to another. Electronic mail messages are sent to a person, not a place. No intermediaries are necessary. Electronic mail provides a way to interact among people on important issues while freeing them to carry out their interaction in real time. At their convenience, users compose, read, answer, forward, file or discard their messages.

The capability to control when the message is received can result in decreased tension among users since they are no longer concerned about missing important information while not at the office. At the same time, there can be a connection among individuals not available with any other existing media [Steinfeld, 1984; Uhlig, 1977; Lawrence, 1980; Keisler, 1986].

Another reason for electronic mail's acceptance is how well it compares to telephone systems. It takes an average of four tries to complete a phone call, and 100 calls to arrange a meeting between six business professionals [Fersko-Weiss, 1985]. With electronic mail, expensive travel can be avoided, as can "telephone tag," where two callers consistently miss each other [Cook, 1984; Sandler, 1983].

Costs of stationery, postage, and labor also can be eliminated in many cases. Electronic records can be saved automatically [Mandela, 1985]. Im-

provements in office behavior, such as time management and conversational behavior, may occur [Losey, 1985; Fersko-Weiss, 1985]. Keisler [1986] believes the absence of social context information, such as letterheads and signatures, increases focus on the message.

Uses of Electronic Mail

For what types of tasks are these electronic messages used? Stanford University researchers found that exchanging information, asking questions, exchanging opinions, staying in touch, and generating ideas were all deemed appropriate uses for computer-based message systems (CBMSs) by more than 50 percent of respondents. Decision-making, exchanging confidential information, resolving disagreements, getting to know someone, and bargaining or negotiating were considered appropriate by between 15 and 50 percent of the respondents. Other less traditional uses for electronic mail include: keeping abreast of company happenings, learning more about events or interests, organizing social activities, brainstorming, opinion polling, and taking a break from work [Steinfeld, 1984]. Employee grievances and resignations have even appeared on one company's internal electronic mail network, as well as constructive criticisms [Emmett, 1981].

Other research has led to similar conclusions. Electronic mail and computer networks are not used as often as the telephone or face-to-face meetings for more important exchanges. Unless the participants know each other well and are working together on the same material, people are reluctant to use the computer link for business. It is considered acceptable for minor or routine information but people often don't trust it for important information [Goleman, 1983]. In most cases, those individuals who were more familiar with the system or were heavy users were more likely to find CBMSs a substitutable medium for face-to-face communication than their counterparts

who were less comfortable with the computer [Rice and Case, 1983].

Nature of the Electronic Medium

As the wealth of communicative clues diminishes from face-to-face interaction to computer terminal interaction, the communication is likely to be considered less friendly, emotional, and personal, and more serious, businesslike, depersonalized, and task oriented [Heimstra, 1982]. In a typical face-to-face conversation people glean information from both verbal and non-verbal sources. In the case of electronic mail, nonverbal cues are eliminated [Short, 1974; Hiltz and Turoff, 1978, pp. 27-30 and 76-125], creating potential problems in complex communication situations, such as bargaining or negotiating, where a direct personal involvement is often desirable. The less personalized setting can lead to loss of empathy and more self-centered communication, increasing the probability of conflict and making agreements more difficult to reach. In group situations, the setting also can lead to the disruption of group hierarchies.

One advantage to this less personalized setting, however, is that the decision is based more on the merits of the case than on the personalities of the bargainers. A more objective decision can be reached [Williams, 1977]. Thus, the computer was deemed most appropriate for tasks that are not perceived as requiring close social distance, such as personal and sensitive communications [Rice and Case, 1983]. It should be noted, however, that despite the impersonality of the system, users can and sometimes do engage in intimate communications. The privacy of the system may encourage the exchange of highly personal and emotional messages, and more than one romance has evolved over the network [Hiltz and Turoff, 1978; Steinfield, 1984].

Social Presence. The findings that people prefer electronic mail for

certain situations more than others relate to the Social Presence Theory. Social presence has to do with the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship. Social presence is regarded as a quality of the communication medium, and media are considered to vary in their degree of social presence. These variations are important in determining how individuals interact. Users of the communication medium are in some sense aware of the degree of social presence of the medium and tend to avoid it for certain types of interactions. This is especially true in interactions requiring a higher degree of social presence than they perceive the medium to have. The amount of a medium's social presence depends on the individual user's perception, so social presence is a subjective quality of the medium [Short, Williams and Christie, 1974, pp. 64-6].

Electronic Propinquity. Another theory, electronic propinquity, also attempts to explain why people prefer the computer more for some situations than others. Propinquity, which means "nearness in place or time" and is synonymous with proximity, might best be explained as the psychological distance between communicators. In face-to-face situations, we see people as real social beings, with unique personalities, feelings and aspirations. Over the more distant media, such as a computer terminal, it is easier to treat others more like objects which can be ignored, insulted, exploited, or hurt with relative impunity.

The more complex the information exchanged, the less propinquity exists. Complex information seems to require the involvement of more senses. We may want to show a chart or picture, or show discontent or affection with facial expressions. The sayings, "a phone call is the next best thing to being there," or, "I can't explain the

problem to you on the phone; let's get together," imply that something is missing that would be added by physical presence. "You could have told me that on the phone," suggests that certain types of information don't require physical presence and are particularly well suited for electronic transmission.

The amount of feedback also relates to propinquity. A lack of nonverbal cues reduces feedback and makes evaluation of the performance more difficult. The more complex tasks requiring more feedback are therefore rated as being less suited for computer use [Korzenny, 1978]. Although far from conclusive [Korzenny and Bauer, 1981], support for this theory has been found through analysis of transcripts of conversations from various media. Audio-only conversations were more depersonalized, argumentative, and narrow in focus, compared with face-to-face conversations [Williams, 1977]. Occurrences of flaming were also more common.

Flaming. Flaming is the computer term for an unseemly outburst that occurs with electronic mail. When a person flames, sentiments are sent to another person's terminal which probably would not be sent in person. the impersonality of the medium possibly contributes to this phenomenon [Sandler, 1982 and 1983]. One person can type something unpleasant to a recipient without fear of a backlash over the phone or in person [Uhlig, 1977]. Also, since the communicator is likely to be alone at the terminal rather than with others, there can be more of a feeling of freedom to express disagreements or suggest potentially unpopular ideas [Hiltz and Turoff, 1978].

A recent study at Carnegie-Mellon University found that computer sessions were, indeed, more turbulent than comparable face-to-face communications. The computer groups took longer to decide, argued more often, and frequently flamed. They exhibited abuse

which never occurred when the students spoke in person. Face-to-face, one vocal participant sometimes dominated the group decision, whereas everyone contributed their opinion and had some weight in the outcome of computer decisions. Such a computer network has been said to suggest a "rowdy democracy" [Goleman, 1983; Dullea, 1985].

Quantity and Content of Messages

Are people communicating with more people more often because of the ease with which computer messages can be sent? And if so, is this resulting in less person-to-person communication? The results are mixed. In the Stanford University study, 57 percent of users received messages from, or sent messages to, people whom they did not telephone or write to before implementation of the computer-based message system. The amount of personal contact reported by these participants did not decrease over time, seemingly unaffected by their increased use of electronic mail [Rice and Case, 1983].

In studying two units of a Fortune 500 company, Sproull and Kiesler similarly found that 62 percent of electronic messages constituted "new" information that would not have been communicated without electronic mail. Of special interest to managers are three other findings of that study: (1) 40 percent of electronic message traffic consisted of recipes, movie reviews and other personal information that was totally unrelated to work; (2) people preferred electronic mail for sending bad news; and (3) people preferred to use electronic mail more for sending messages to superiors than to subordinates. Other research has led to different conclusions. There is evidence that some people come to rely on their terminal, preferring electronic messages to conversing face-to-face. Coworkers have been seen passing in the hallway and one worker says to the other, "I'm going to send you a message," rather

than talking to each other then and there. So while it is agreed that in general computer-mediated communication system users are communicating more, they may actually be talking to one another less [Norman, 1982 and 1983].

Length of Messages

It appears that users of computer-based message systems are communicating more often and with more people. But has there been any effect on the length of those messages? There seems to be conflicting evidence for both longer and shorter communications. One school of thought argues that because a response does not have to be made immediately, as in a face-to-face conversation, the respondent can become more attentive to what is being transmitted: "The individual messages and statements tend to be short and terse, given that extra time to think things over" [Norman, 1983]. Also, since the speed of transmission of these messages is limited by the physical constraints of actually typing the message, they tend to be less wordy. Users cut out redundancy in an effort to compensate for this slowness [Williams, 1977]. Short, sharp communication is encouraged [Perkins, 1982].

Others argue that the computer screen compels people to write more. Paragraphs look shorter on an 80-character line on a terminal screen than they do on a printed page. The word-wrap facility of computer terminals probably encourages longer sentences, also. Without having to hit the carriage return frequently, sentences can become much more wordy. In addition, the presence of the video screen can encourage more voluminous compositions. Since paper after page disappears effortlessly into the terminal, with no visible accumulation of work, it can be easier to say more than is necessary [Supplee, 1984].

Quality of Writing

Another question about computer writing is whether there are noticeable effects on the quality of writing that is produced electronically. That is, will spelling, grammar, sentence structure, clarity of thought, and readability be better or worse when generated as computer mail? Again, opinions are divided. Those who see better quality cite the ease of revision and freedom from the constraints of written information as reasons for improvement in quality. The flexibility gained with word processing capabilities is analogous to the thinking process where information can be altered in almost any way at any time, encouraging uninhibited entry and manipulation of ideas [Uhlig, Farber and Bair, 1979, pp. 338-40].

Support for this flexibility comes from research by Marcus and Blair [1984], who determined that "invisible writing" exercises, where the computer monitor's display is turned off, sharpened concentration, enhanced fluency, and made writing more cohesive [see also, Gralla, 1987]. In a somewhat similar approach, the initial step in the writing process--brainstorming: using tagmemic devices, inventing, and organizing--receives more attention when composition occurs on a computer [Tampplin, 1986].

The extra time available to compose one's thought is another purported reason for improvement in quality of writing. A user alone in a room with a machine tends to become more reflective and/or introspective [Hiltz and Turoff, 1978]. Communicating by computer requires the discipline of putting thoughts into writing before sending them, resulting in improved organization and clarity. Since messages are initiated when the sender desires, and not upon demand by someone else, comments are generally much clearer and better thought out than what is frequently spoken in person. Also, it is easier to pay attention to written text than to a face-to-face meeting, which

can lead to better quality of communication [Uhlig, 1977; Norman, 1983].

Further, communication generated by computer can create a subjective impression of quality in the mind of the recipient. Managers may start using the terminal more because it makes them appear more professional and technologically savvy, fostering a feeling of quality in their minds as well [Gatty, 1984; Smeltzer and Waltman, 1984].

Other researchers feel differently, however. They speculate that as computers become more widespread in organizations and as decision makers become comfortable with computers, certain communication errors may actually increase. Some managers assume that anything generated by a computer is correct. As a result, proofreading and editing may be neglected. For messages of lesser importance, typographical errors may be left uncorrected with the thought that "they'll know what I mean." In some settings, capitalization has even become optional.

Deliberate grammatical errors are also occurring as a means of adding verbal cues to replace the nonverbal cues that are lost. For instance, when humor is intended but not obvious, the words, "ha, ha" can be inserted to ensure the statement is interpreted correctly. Similarly, "boo hoo" is used to signal disappointment [Steinfeld, 1984; Hiltz and Turoff, 1978]. It can be hypothesized that as these occurrences become more common and acceptable, the skills associated with proper grammar might atrophy, resulting in poorer communication skills overall. Managers may take less time than required for planning the communication because of the speed with which the communication can be implemented. They also may become more lax in their grammar and sentence structure as these skills become less important [Lawrence, 1980; Smeltzer and Waltman, 1984].

A STUDY OF COMPUTER VERSUS NON-COMPUTER WRITING

To test some of the literature's divergent findings, an experiment was designed around four major differences between computer and non-computer writing: readability, "personalness," verb voice, and mechanical soundness.

Methodology

Through a laborious recruitment process, the authors eventually identified 23 faculty and students of a major Southwestern university who could and would provide six appropriate samples of their correspondence (three computer-based samples and three paper-based samples). Potential subjects were contacted, directly and indirectly, by paper-based memos and by electronic bulletin boards and mainframe computer mail systems.

Readability. There are those who argue that computer writing is more concise and better thought out than non-computer writing [Norman, 1983]. This would lead to higher readability scores for computer writing. Others feel that writers become more verbose when working at a terminal, with correspondingly lower readability scores [Suplee, 1984]. We asked, "Is computer-based writing more or less readable than non-computer-based writer?"

To measure readability, Flesch's Reading Ease formula was used [Flesch 213-16]. This formula emphasizes length; the longer the words and sentences, the harder to read. In this study, random samples of approximately 100 words were used.

Personalness. Another area of disagreement about the two forms of writing is the discrepancy as to the amount of social distance that people perceive for the electronic medium. Some feel that social distance is increased by the computer [Rice and

Case, 1983; Korzenny, 1978]. On the other hand, the privacy of the system may encourage the exchange of highly emotional and personal messages, including romantic exchanges [Hiltz and Turoff, 1978]. Our question: "Is computer-based writing more or less personal than non-computer-based writing?"

To measure "personalness," Flesch's Human Interest formula was used. Human interest, in part, is the ratio of personal words per 100 words. Personal words are: (a) all first-, second-, and third-person pronouns, with a few exceptions; (b) all words that have masculine or feminine natural gender; and (c) the group words "people" and "folks."

Verb Voice. Related to the theory of social presence is a question of whether social presence has an affect on verb voice. Examples of flaming would probably exhibit a more active tone, but longer, more cerebral discourses might tend to be more passive. We wish to know, "Is computer-based writing more aggressive (active voice) or more detached (passive voice) than non-computer-based writing?"

To measure verb voice, the same 100-word samples used in the previous two measures were studied. The number of active voice and the number of passive voice occurrences per 100 words were calculated.

Mechanical Soundness. Finally, the degree of mechanical soundness of the writing could be affected by the medium. The ease of revision afforded by computer editing is a strong argument for a higher degree of mechanical soundness [Uhlig, 1977]. Further, software packages are readily and inexpensively available which check writing for spelling, grammar, and punctuation [Penrose, 1984 and 1986]. On the other hand, the speed with which computer writing can be composed and trans-

mitted may lead to hasty, inadvertent grammatical errors [Lawrence, 1980; Smeltzer and Waltman, 1984]. Also, deliberate grammatical errors are sometimes used to add verbal cues where nonverbal cues would be lost [Steinfeld, 1984]. We ask, "Is computer-based writing more or less mechanically sound than non-computer-based writing?"

Mechanical soundness was measured by the number of grammatical and/or spelling errors per 100 word sample. All errors were counted, regardless of intentionality. For instance, capitalizing all the letters of a word for EMPHASIS was still considered an error. Spelling errors, whether typographical or otherwise, were counted as well.

Results and Analysis

The Kruskal-Wallis H Test was used to determine whether differences between computer and non-computer writing samples were statistically significant, at a confidence level of 95 percent, on the dimensions of reading ease, personalness, active versus passive voice, and mechanical soundness. On none of the four dimensions was there a significant difference between computer-based and noncomputer-based writing.

In this case, however, the fact that no statistical significance was found is misleading. Because the statistical test is an aggregate measure of the difference between the computer writing samples and the noncomputer writing samples, it masks important individual differences. For example, in Table 1 below, the readability of computer-based writing and noncomputer-based writing is virtually the same ($44.3 - 44.1 = 0.2$ difference); but the average difference between an individual's scores is 11.8. Similar results occurred on each of the other indices.

TABLE 1: COMPARISON OF COMPUTER AND NONCOMPUTER WRITING

INDEX (1) (2)	NONCOMPUTER VALUE (X)	COMPUTER VALUE (Y)	DIFFERENCE BETWEEN (X) and (Y)	MEAN WITHIN-SUBJECTS DIFFERENCE BETWEEN NONCOMPUTER AND COMPUTER VALUES	NUMBER OF SUBJECTS WHOSE NONCOMPUTER VALUE IS HIGHER THAN THEIR COMPUTER VALUE
1. READING EASE					
mean	44.1	44.3	0.2	11.8	13 (3)
std. dev.	15.0	15.9			
2. HUMAN INTEREST					
mean	24.5	27.3	2.8	12.7	12
std. dev.	15.3	18.5			
3a. ACTIVE VERB VOICE					
mean	9.5	9.3	0.2	2.1	13
std. dev.	2.4	3.1			
3b. PASSIVE VERB VOICE					
mean	1.6	1.5	0.1	1.2	14
std. dev.	1.1	0.9			
4. MECHANICAL SOUNDNESS					
mean	1.1	0.9	0.2	0.9	13 (4)
std. dev.	1.1	1.4			

(1) Scales are not comparable; values on different indices cannot be compared to each other.

(2) No index was significant on Kruskal-Wallis H Test at the 0.05 level.

(3) Number of subjects in the experiment = 23.

(4) Excludes four subjects with perfect scores of 0.00 on both computer and noncomputer writing samples.

Thus, it appears that different people's writing habits and style may change in quite different ways when they move from pencil-and-paper or typewriter to the keyboard of an electronic mail system. In this study, for example, 13 individuals' readability scores improved, while 10 deteriorated. It is possible, of course, that the changes represent natural variability in the sample or inadequate controls in the study; but the magnitude of the changes suggests that significant, albeit conflicting factors are at work.

In the terminology of experimental design, there appear to be significant "interaction" effects (perhaps between individuals and the electronic technology), despite the absence of "main" effects (in the form of aggregate differences between computer-based and noncomputer-based writing). What the individual differences might be, however, is not obvious. They may be a combination of personality factors and attitudes toward technology. Teasing out these possible factors would be an ambitious but appropriate subject for future research.

CONCLUSIONS

Based on a review of the litera-

ture, we can draw a few relatively firm conclusions about computer-mediated communication. First, electronic mail is increasing the sheer volume of communications within organizations, and it is growing rapidly. Second, because it has weak social context cues, electronic mail is better suited to certain types of communication than to others. Third, for many tasks, electronic mail enables us to communicate more quickly, more flexibly and more efficiently than ever before.

We are less sure about how the computer affects the content, tone and other characteristics of our day-to-day communications. Competing theories seem to have significant explanatory power in specific contexts. Indeed, the results of the original study conducted for this paper suggest that these theories may turn out to be more complementary than conflicting when we are better able to partition the "individual" differences among computer users into meaningful personality and attitudinal variables. In the meantime, understanding the general nature of computer-mediated communication, including its inherent advantages and potential pitfalls, is likely to improve the effectiveness of our daily communications.

REFERENCES

- Beagley, Karen. "The Demise of 'Telephone Tag.'" *Infosystems* 31, 11 (November 1980), pp. 130-1.
- Cook, William J. "No More Telephone Tag." *PC Magazine* 3, 20 (October 16, 1984), pp. 377-80.
- Cooper, Michael. "In the Stretch: Electronic Mail." *Public Relations Journal* 41, 1 (January 1985), pp. 20-4.
- Emmett, R. "VNET or GRIPENET?" *Datamation* 27, 2 (December 1981), p. 48.
- Dullea, Georgia. "Computer Communications Keep Sociologists Speculating." *Onward* supplement to the Austin, Texas, American-Statesman (April 16, 1985), p. 16.
- Fersko-Weiss, Henry. "Electronic Mail: The Emerging Connection." *Personal Computing* 9, 1 (January 1985), pp. 71-9.

- Flesch, R. *The Art of Readable Writing*. New York: Harper and Brothers, 1949.
- Fuerst, Judith A. "Electronic Mail: Seize the Moment." *Handling and Shipping Management* 26, 11 (October 1985), pp. 40-4.
- Gatty, B. "Computers as Mailboxes." *Nation's Business* 72, 1 (January 1984), pp. 62-4.
- Goleman, D. "The Electronic Rorschach." *Psychology Today* 17, 2 (February 1983), pp. 36-43.
- Gralla, Preston. "Packages Cater to All Phases of the Writing Process." *PC Week* (May 26, 1987), p. 131.
- Hiemstra, G. "Teleconferencing, Concern for Face, and Organizational Culture" *Communication Yearbook* 6 (1982), pp. 874-904.
- Ichard, A. "New Directions for Electronic-Mail Service." *Telecommunications* 19, 8 (August 1985), pp. 36-45, 53.
- Keisler, Sara. "Thinking Ahead: The Hidden Messages in Computer Networks." *Harvard Business Review* (January-February 1986), pp. 46-60.
- Kolodziej, Stan. "Where Is the Electronic Messaging Explosion?" *Computerworld* 19, 41A (October 16, 1985), pp. 21-3.
- Korzenny, F. "A Theory of Electronic Propinquity: Mediated Communication in Organizations." *Communication Research* 5, 1 (January 1978), pp. 3-24.
- Korzenny, F., and C. Bauer. "Testing the Theory of Electronic Propinquity." *Communication Research* 8, 4 (October 1981), pp. 479-98.
- Lawrence, B. "Computer Based Message Systems." *Online* 4, 3 (July 1980), pp. 6-7.
- Mandela, Audrey. "Electronic Express." *Popular Computing* (March 1985), pp. 82-8.
- Marcus, Stephen, and Sheridan Blair. "Not Seeing is Believing: Invisible Writing with Computers." *IEEE Transactions on Professional Communication* PC-27, 2 (June 1984).
- Norman, D. A. "The Trouble with Networks." *Datamation* 28, 1 (January 1982), pp. 188-92.
- Norman, D. "The Computer Always Rings Twice." *Psychology Today* 17, 10 (October 1983), pp. 46-50.
- Penrose, J. "Computer Software Review." *ABCA Bulletin* 47, 3 (September 1984), pp. 22-24.
- Penrose, J. "A Computer Software Review of Rightwriter." *ABC Bulletin* (June, 1986), pp. 11-14.
- Perkins, F. J. "The Electronic Mailbox." *The Office of the Future: Planning for Electronic Mail*. Brookfield, VT: Gower Publishing Co., 1982, pp. 53-8.

Rice, R. E., and D. Case. "Electronic Message Systems in the University: A Description of Use and Utility." *Journal of Communication* 33, 1 (Winter 1983), pp. 131-51.

Losey, Cheryl. "Electronic Messaging Systems for More Effective Management." *IEEE Transactions on Professional Communication* PC-28, 3 (September 1985), pp. 35-9.

Sandler, Corey. "Electronic Mail: The Paperless Revolution." *PC Magazine* 1, 9 (January 1983), pp. 52-8.

Sandler, Corey. "Electronic Mail: Why Sparks Fly in Messages." *PC Week* (April 16, 1985), p. 32.

Short, J. A. "Effects of Medium of Communication on Experimental Negotiation." *Human Relations* 27, 3 (March 1974), pp. 225-34.

Short, J., E. Williams, and B. Christie. *The Social Psychology of Telecommunications*. London: John Wiley and Sons, 1976.

Smeltzer, L. R., and J. L. Waltman. *Managerial Communication: A Strategic Approach*. New York: John Wiley and Sons, 1984.

Sproull, L., and S. Kiesler. "Reducing Social Context Cues: Electronic Mail in Organizational Communication." *Management Science* 32, 11 (November 1986), pp. 1492-1512.

Steinfeld, C. Presentation at The University of Texas at Austin, June, 1984.

Suplee, C. "Electronic Writing: The PC Tapping at the Chamber Door." *PC Magazine* 3, 19 (May 29, 1984), pp. 249-55.

Tamplin, John. "Word Processing-Does It Work?" *Electronic Education* (January 1986), pp. 10-16.

Uhlig, R. P. "Human Factors in Computer Message Systems." *Datamation* 23, 5 (May 1977), pp. 120-6.

Uhlig, R. P., D. J. Farber, and J. H. Bair. *The Office of the Future*. New York: North-Holland Publishing Co., 1979.

Williams, E. "Experimental Comparisons of Face-to-Face and Mediated Communication: A Review." *Psychological Bulletin* 84, 5 (September 1977), pp. 963-76.