Pergamon

Technology In Society, Vol. 18, No. 2, pp. 219–230, 1996

0160-791X/96 $15.00+0.00

S0160-791X(96)00009-7

Communicating New Ideas: The Potential Impact of Information and Telecommunication Technology

Kathleen M. Carley

ABSTRACT. Information and telecommunication technologies are expected to facilitate rapid information diffusion and homogenize society. These expectations, however, are based on the assumption that the underlying structure and culture of society remains unchanged. When new technologies are introduced and the structure of society changes, the advantages of the new technology may not be clear. Specifically, in conjunction with the move to modern information and telecommunication technologies, if both the size of the group and the amount of information increases, then the expected speedup in information diffusion may not be realized. Moreover, ITT may also increase the relative rate at which information diffuses to smaller and more intellectually advantaged groups, thus exacerbating social differences. Copyright © 1996 Elsevier Science Ltd

Popular and academic press are rife with discussions on the impact of information and telecommunication technologies on society. Terms such as the "information society," the "networked nation," the "global society," "telescience," and the "networked organization" speak to a growing assumption that telecommunication technologies will become ubiquitous and that such omni-presence will have the major effect of getting more information to more people more quickly. This generic assumption aside, researchers and

Kathleen Carley is an Associate Professor of Sociology and Organizations at Carnegie Mellon University with a Ph.D. in Sociology from Harvard University. Her research is in the areas of social and organizational networks, organizational change and performance, computational organization theory, communication and technology, social theory, communication and diffusion, and textual analysis. Current projects include: the impact of member's skills, organizational design and strategies, on the organization's performance and ability to respond to a changing environment; the interplay of social structure, cognition, and technology in affecting information diffusion and group formation; encoding mental models from texts; development of statistical and computational techniques for the analysis of social networks and their evolution over time.

futurists provide a dizzying array of visions for the 21st century. These writers provide a variety of views on whether these technologies will advantage all groups equally, or only a select few.

While most agree that information and telecommunication technologies (ITT) have the potential for creating a global network, there are multiple views on how behavior will be affected by the simple ability of the members of this extended community to rapidly interact among themselves and access information.[1, 2] A great deal of research has demonstrated that various communication technologies can have profound social, and even psychological, consequences and that these consequences are dependent on various features of the technology such as enabling one-to-many communication.[3-5] ITT will influence the way in which work is done in society,[5-7] the type of work that is done,[8] how individuals are trained to take their place in society,[9] and how organizations will communicate[10] and be redesigned.[11] Nevertheless, there are disagreements. On the one hand, ITT is seen as having a leveling or homogenizing effect and so leading to a global culture.[10] On the other hand, whether it is even possible for ITT to create an "information society" is questioned.[12] Electronic mail, for example, has been studied extensively with respect to its effects on communication style and its ability to break down geographic or social boundaries;[13-18] but may not always do so.[19, 20] Electronic mail has been shown to facilitate many types of communication, such as the development of panels for conferences,[21] group coordination,[22] and interpersonal communication;[23-25, 14] however, whether all types of communication are equally advantaged is not clear. Overall, in the world of virtual reality it is simply not clear what information will be diffused, how, and to whom;[26] it is simply not clear what effect ITT will have other than to speed up the flow of information.

Research on the impact of ITT often focus on the features of those technologies. The basic assumption is that differences in these features will, in and of themselves, be sufficient to effect social change. However, there are complex interactions between ITT, the underlying socio-cultural environment, the content of the communication, and the sheer volume of information and communications.

For example, although ITT enables communication to the masses through one-to-many communication, that does not guarantee that a particular piece of information will diffuse. There is a difference between an innovators potential and actual reach (number of others to which information can/does diffuse). ITT increases the former, but not necessarily the latter. Rather the diffusion of specific information depends on the way it is presented and whether there is a point of contact for the consumer, some content that ties the new idea to previously held ideas.[27, 28] Without this supporting content, new ideas are less likely to diffuse and individual innovators will not reach with their new idea all those others whom they have the potential to reach. In general, the content of communications need to be carefully designed for maximal reach.[27, 29]

As another example, ITT enables not only communication to the masses;

but also, communication from the masses. Many researchers have discussed the existence of information overload[30] and questioned the ability of individuals to absorb the vast quantities of information made available by ITT.[31] Research has demonstrated that information overload can degrade decision making performance when individuals are under time pressure[32] and that it is the diversity of information, and not just the amount of information, that affects decision making performance.[33] Strategies for dealing with information overload have even been suggested.[34] However, the potential increase in information enabled by ITT may be advantageous. That is, some increase in the number of innovative messages diffusing through one-to-many technologies may actually increase the rate at which any of the new ideas diffuse.[27, 28]

Finally, consider the interaction between ITT and the underlying socio-cultural environment. The literature on ITT has its predominant emphasis on the features and use of the technology,[18, 35, 36] its psychological and social-psychological consequences,[4, 14, 16, 37, 38] and its historical impact.[39-41] Rarely do these studies focus on the structure of the underlying socio-cultural environment and how changes in that environment, that may co-occur with the advent of the technology, might alter the impact of the technology. Two issues are of critical importance. First, is there an interaction between the size of the population and the impact of ITT? Second, is there an interaction between the use of ITT and the shape of the underlying social network (the web of relations linking individuals to each other) that affects the diffusion of information?

ITT are thought to have greater speed and flexibility than conventional communication channels (e.g. they support both one-to-one interaction and one-to-many interaction). Based on these technological differences, researchers have argued that we may see the development of far-flung interpersonal networks held together by telephone interaction;[42] and the creation of extended research groups at multiple research sites.[22] Such interpersonal and scientific networks have the potential to be much larger than the networks of the past.[43] ITT may increase the size of communication groups. Historically, as group size grew the speed at which information could diffuse within the group decreased. But what does it mean for size of the group to grow when the group is linked through ITT?

Diffusion researchers have long argued that the shape of the underlying social network, the structure of the society, affects the rate at which information diffuses and who is relatively advantaged in gaining access to new information.[44] For example, a study of two separate Dutch neighborhoods demonstrated that the diffusion of information depended on the number of network ties in the community.[45] In general, the potential reach of the innovator depends on the underlying structure of the society.[27] With respect to ITT a frequently asked question is whether ITT will replace or enhance existing networks or social structures.[46] Claims about how the ITT altered the underlying social structure abound; e.g. print communication made possible the professions by enabling regular and rapid contact,[47] and electronic

communication increases connectedness among individuals and decreases their isolation.[13] However, whether there is an interaction between structure and technology is not known. That is, it is not known whether the type of socio-cultural landscape that facilitates rapid diffusion will depend on the type of ITT available to the members of the society.

The foregoing discussion suggests that a change in communication technology is not just a change in technology, but also can co-occur with, and may even result in, changes in the underlying socio-cultural landscape. Questions, such as those previously raised, are being addressed using a number of approaches including field studies, experiments, and computer simulation. It is difficult for people to think through the implications of these kind of dynamic systems unaided by accounting devices. Computational models, in particular, provide a promising avenue for addressing these concerns as they allow the researcher to examine these dynamic systems in a systematic fashion, and to study long term effects, larger populations, and a greater variety of ITT. Researchers in this area can bring to bear the power of complex adaptive agent modeling techniques and an understanding of social networks in addressing the issue of the impact of ITT. Consequently, the models available today have a higher degree of realism and accuracy than previous diffusion models. These computational models can be thought of as the embodiment of theory and their predictions as hypotheses which can be tested in later studies.

Herein, a particular computational model of information diffusion is used to examine the interplay between the underlying socio-cultural landscape and ITT in affecting the rate at which information diffuses. The specific model used is based on the constructural theory.[48-50] According to this theory, information diffuses as individuals interact, and as individuals learn the innovative information their body of knowledge changes which in turn affects whom they choose to interact with in the future. Interaction partners are chosen on the basis of relative similarity. As individuals change whom they interact with the social network changes. As the social network changes who communicates what to whom changes. ITT can have a variety of effects including adding new communication partners and altering the number of individuals with whom the individual can communicate at once. Unlike traditional models of diffusion this model has multiple pieces of information diffusing simultaneously and thus competing for the attention of the individuals. And, unlike traditional models of diffusion, the individuals alter what they know and so their probability for learning the new piece of information over time may decrease. And, unlike traditional models of diffusion, the underlying social structure can change over time.

Using this model a series of virtual experiments are run in which the shape and size of the initial underlying social structure are varied. Two communication technologies are considered. The first technology can be thought of as standard one-to-one communication. This can be thought of as simply talking. The second technology differs only in that it allows the individuals to communicate in a one-to-one or one-to-many fashion. This can be thought

of as email. In all cases, the rate at which a particular piece of information, and the rate at which all of the information in the society, are communicated to the entire population are tracked. There exists a single innovator, an individual who discovers a new idea, in each of the artificial societies examined. Initially, this idea is known only by the innovator. The results shed light on the interplay between social structure and ITT in affecting the rate of information diffusion.

Potential Impact of ITT On Diffusion

Most researchers will agree that ITT will speed up the rate at which information diffuses. In a sense, such an argument dismisses what may be the more important social consequences of ITT, the subtle shifting of which subgroups become more or less advantaged by the presence of ITT. If the relation between the socio-cultural landscape and the rate of information diffusion remained the same but faster as ITT enter society, then in a sense, ITT would be having a trivial effect on society. But is this case? Are the types of groups and societies that are afforded the highest/lowest rate of diffusion under only one-to-one communication the same as those when one-to-many communication is also easily available to the masses?

Let us begin by considering the tradeoff between the rate of information diffusion and population size (Fig. 1). The results suggest that as the size of the group grows information diffuses more slowly and that this effect is even more pronounced in an ITT environment. This suggests that as ITT become more prevalent, that groups that remain smaller will have a greater

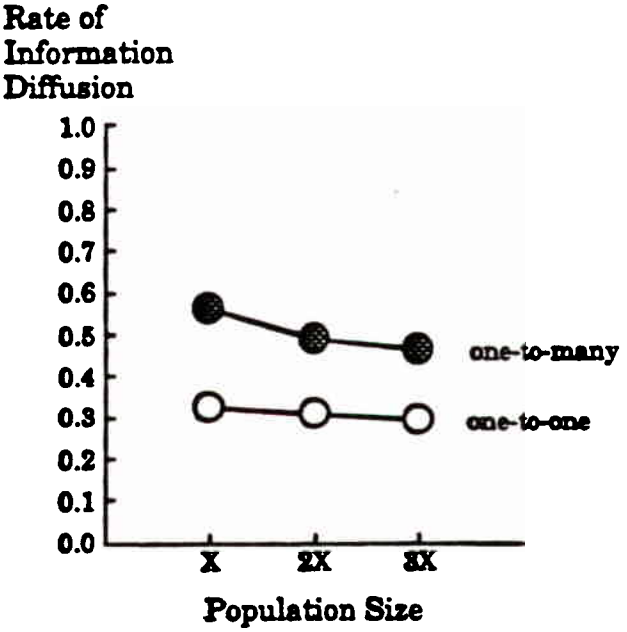

Figure 1. Rate of information diffusion and population size

advantage to learning new information. If learning novel information first is advantageous economically or socially then smaller groups will be advantaged. In principle, in an ITT environment groups can grow arbitrarily large as they need no longer rely on one-to-one communication to maintain close ties to each other. However, these results suggest that groups may still wish to restrict their membership and so remain small in an ITT environment as by doing so they can reap a greater advantage from the increased rate of diffusion afforded by ITT. These results also suggest that if groups automatically grow in size as them move to an ITT environment they may not see an increase in the rate of diffusion. The group may be larger, but it still may take as long to learn novel information.

Now consider the tradeoff between the rate of information diffusion and the complexity of the culture (Fig. 2). We can think of cultural complexity as the amount of information in the society. Regardless of the communication technology, new information diffuses more slowly the more other information there is in the community. An effect of information overload is simply that as the amount of information that can be communicated increases the rapidity with which any one piece of information may diffuse on average decreases. The results suggest that as the amount of available information grows information diffuses more slowly and that this effect is even more pronounced in an ITT environment. This suggests that as ITT become more prevalent, that groups that restrict information in general will have a greater advantage in learning specific new information. If learning novel information first is advantageous economically or socially then cultural or knowledge

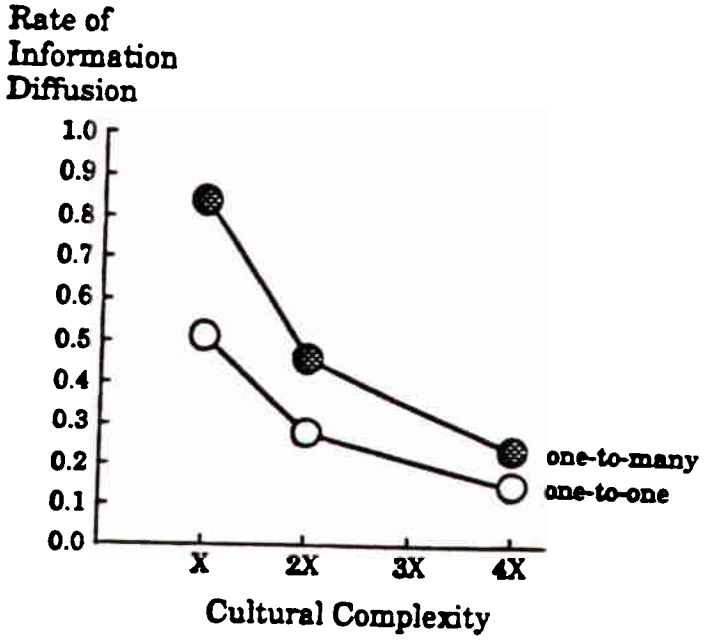

Figure 2. Rate of information diffusion and cultural complexity

restriction will be advantageous. In an ITT environment the amount of information available is expected to grow arbitrarily large. However, these results suggest that groups may still wish to restrict information in an ITT environment as by doing so they can reap a greater advantage from the increased rate of diffusion afforded by ITT. Intellectual gatekeepers or high information accessing costs which may restrict the growth of information in general have the paradoxical impact of increasing the rate at which new information will diffuse; and such restrictive mechanisms may have even greater impact in an ITT environment. These results also suggest that if the amount of information in a groups automatically grows as they move to an ITT environment the group may not see an increase in the rate of diffusion. The group may become more culturally complex, but it still may take as long, or even longer, to learn novel information.

Gantz *et al.*[51] found that while 80% of individuals first hear about local news events through interpersonal sources, mass media quickly becomes the dominant provider of follow-up and detailed information on the event. If as I have been suggesting, smaller groups are more advantaged by ITT than are larger groups, then they are likely to here a novel idea fast enough to prevent it from going out to masses. If more complex cultures less advantaged than simpler cultures by ITT then even though individuals access mass media sources for information the sheer increase in information in the ITT environment may still decreases the speed with which individuals are able to access the follow-up information. If ITT increases the amount of information available on any event then individuals in these societies will spend more time utilizing mass media to locate follow-up and detailed information than will individuals in simpler and non ITT cultures.

So far the discussion has been only in terms of the rate at which one piece of information, the novel piece of information, is diffusing. Other pieces of information are also diffusing at the same time. In general, the novel piece of information diffuses faster on average than the rate at which the members of the society come to know all of the other information under both ITT and non ITT conditions. However, the correlation between the rate of diffusion of one piece of information and rate of diffusion of all pieces of information moves from 0.686 to 0.825 as the society moves from only one-to-one communication to also admitting one-to-many communication. This means, that in an ITT environment, all pieces of information are equally advantaged and that the society is less likely to exhibit social artifacts and fads caused by one piece of info hitting the news before the competing or contradictory piece of information. In this sense, in an ITT environment unfounded rumors should be short lived.

Now let us consider how ITT might affect subgroups or minorities (Fig. 3). When there are two groups, the smaller the minority relative to the majority, the faster novel information diffuses to the group relative to the rest of society. And, in an ITT environment, the smaller the minority the more advantaged they are. This suggests that innovative groups, research and development organizations, and intellectual communities may wish to

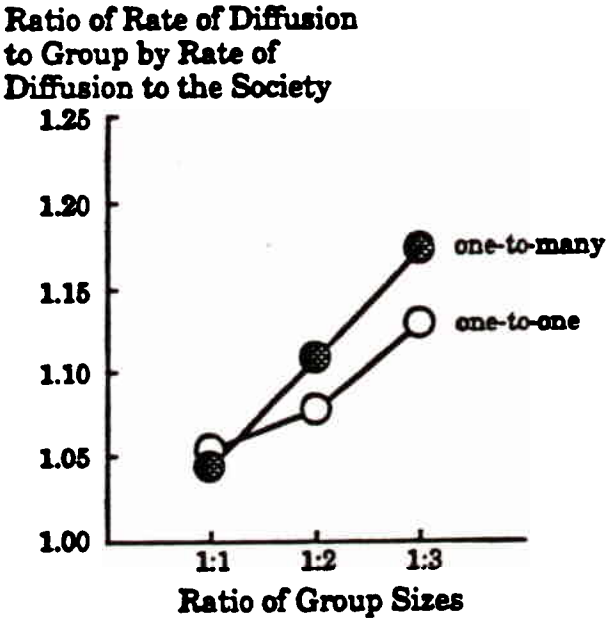

Figure 3. Ratio in rate of diffusion and ratio of group sizes

restrict membership so that the new ideas they generate will diffuse first within their group.

In societies without ITT novel information tends to diffuse to the new group almost as rapidly as it does to the group as a whole (correlation of 0.801 when only one-to-one communication is available). In an ITT environment there is less relation between when the group gets the new information and when the society as a whole receives the novel information (correlation of 0.507 when one-to-many communication is also available).

ITT is often characterized as overcoming at least two human limitations-ability to track or remember information and ability to communicate with more individuals at the same time. It is often argued that technology which overcomes human limitations should advantage the disadvantaged and this mitigate human differences. This argument can be examined by seeing whether novel information will diffuse relatively more quickly to groups with less initial intellectual capital, less initial knowledge, in an ITT than in a standard one-to-one communication environment. In Fig. 4, we see that ITT, rather than having a leveling effect is actually exacerbating social differences. That is information diffuses faster to the more advantaged groups, the ones with more initial knowledge. Further, in an ITT environment the difference in the rate of diffusion to the least and most knowledgeable group is higher than in a one-to-one environment.

Huber[52] has argued that ITT may not automatically have a leveling effect on society. He suggests that "in a free, market-driven society, powerful new technology shifts the whole human bell curve to the right. Advanced technology should be diverted to the least gifted kids in the poorest schools

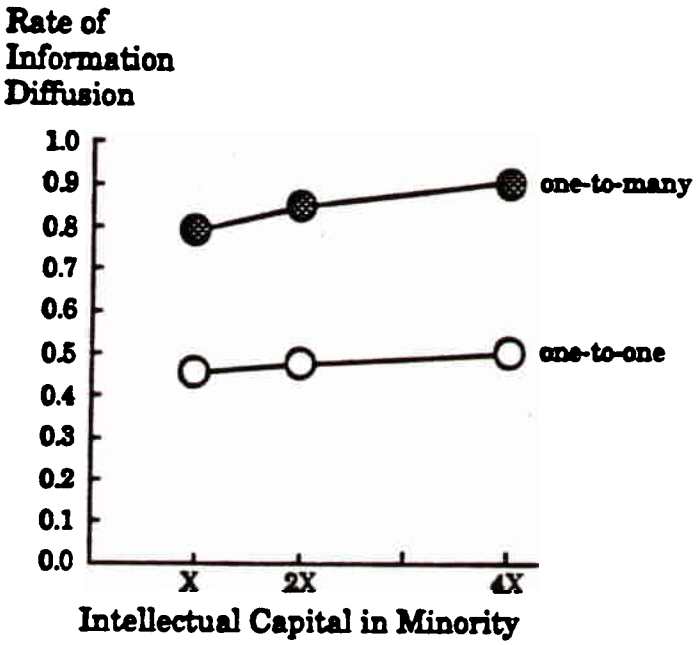

Figure 4. Rate of information diffusion and intellectual capital

resulting in a social equalizer." In other words, conscious intervention may be necessary for ITT to actually overcome human limitations and advantage the disadvantaged. The forgoing results are consistent with his prediction. Moreover, they suggest that in an ITT environment the difference between the intellectual haves and have nots may actually grow as novel information may be communicated faster to those who start out intellectually advantaged.

Commentary

This analysis calls into question the general assumption that ITT will facilitate rapid information diffusion. It suggests that if the move to ITT also effectively increases group size and or the amount of available information that the expected speedup in information diffusion may not be realized. This analysis also suggests that smaller groups will be afforded greater advantages by ITT than large groups; but, that ITT will not automatically overcome intellectual disadvantages and may even exacerbate differences. These results should be thought of as predictions which need to be tested through empirical studies.

.The foregoing results are due in large part to the fact that even in an ITT environment information will not always be broadcast to all, but may travel by both one-to-one and one-to-many channels and the many to which it is transmitted may not be the entire group. In other words, ITT increases the options available for communicating novel ideas, it does not guarantee that the fastest mechanism will be used. In general, interpersonal ties, such as

friendship, neighbor, and mentor-student relationships coordinate the diffusion of new information.[53] In an ITT environment, novel information may be communicated through less proximal ties, but there will still be a reliance on known others for information. In general interpersonal ties move information slowly as they rely on one-to-one contact. In an ITT environment, novel information may move more quickly due to the possibility of one-to-many communication.

The foregoing results are also due to the fact that the underlying social structure is changing in response to the technology and the interactions among the members of the society. For example, in the artificial societies examined the groups became more homogenous more rapidly when one-to-many communication was enabled in addition to one-to-one communication. Research is needed to understand the relative impact of ITT when the underlying social structure is changing.

The foregoing discussion has focused on changes in the rate at which information diffuses. Clearly, ITT might also affect what type of information diffuses and the way in which information is presented. Such changes may effect radical changes in society that are not accounted for simply by examining the rate of information diffusion.

Altenpohl and Lohmar[54] argued that the future would be determined not by new technology, but by how societies exploited the opportunities those technologies represent. To this I would add that new technologies provide not just opportunities but constraints. The interaction between the new technology and the initial social structure can radically alter the extant social structure. Consequently, predictions made about the impact of a technology on society based on the current social structure are likely to be wrong. Understanding the impact of new technologies, particularly communication technologies, can only be done within a social context. The future, is thus determined not just by how societies exploit the opportunities those technologies represent but also by how the societies change in response to a technology and so generate new social and technological opportunities and constraints.

Notes

1. L. M. Harasim, *Global Networks: Computers and International Communication* (Cambridge, MA: MIT Press, 1993).
2. J. L. Salvaggio, *The Information Society: Economic, Social, and Structural Issues* (Hillsdale, N.J.: Lawrence Erlbaum, 1989).
3. D.J. de S. Price, "Networks of Scientific Papers," *Science*, Vol.149 (1965), pp. 510-515.
4. R. E. Rice, *The New Media: Communication, Research, and Technology* (Beverly Hills, CA: Sage, 1984).
5. L. Sproull and S. Kiesler, *Connections: New Ways of Working in the Networked Organization* (Cambridge, MA: MIT Press, 1991).
6. H. Ishii and N. Miyake., "Toward an Open Shared Workspace: Computer and Video Fusion Approach of TeamWorkStation," *Communications of the ACM*, Vol. 34, no. 12 (1991), pp. 36-50.
7. R. E. Kraut and L. A. Streeter, "Coordination in Software Development," *Communications of the ACM*, Vol. 38 (1995), pp. 69-81.
8. R. Hanson, "Urbanization and Development: Policy Issues for the States," *Journal of State Government*, Vol. 60, no. 3 (1987), pp. 106-109.

9. S. B. Kiesler and L. Sproull (eds.), *Computing and Change on Campus* (New York: Cambridge University Press, 1987).
10. A. K. Kozminski and D. P. Cushman (eds.), *Organizational Communication and Management: A Global Perspective* (Albany: State University of New York Press, 1993).
11. J. Richter and I. Meshulam, "Telework at Home: The Home and the Organization Perspective," *Human Systems Management*, Vol. 12, no. 3 (1993), pp. 193–203.
12. F. Webster, "What Information Society?," *Information Society*, Vol. 10, no. 1 (1994), pp. 1–23.
13. S. R. Hiltz and M. Turoff, *The Network Nation: Human Communication via Computer* (Reading, MA: Addison-Wesley, 1978).
14. L. C. Freeman, "Impact of Computer-Based Communication on the Social Structure of an Emerging Scientific specialty," *Social Networks*, Vol. 6 (1984), pp. 201–221.
15. S. R. Hiltz, *Online Communities: A Case Study of the Office of the Future* (Norwood, NJ: Ablex, 1984).
16. S. Kiesler, J. Siegel and T. McGuire, "Social Psychological Aspects of Computer-Mediated Communication," *American Psychologist*, Vol. 39 (1984), pp. 1123–1134.
17. L. Sproull, S. Kiesler and D. Zubrow, "Encountering an Alien Culture," *Journal of Social Issues*, Vol. 40 (1984), pp. 31–48.
18. L. Sproull and S. Kiesler, "Reducing Social Context Cues: Electronic Mail in Organizational Communication," *Management Science*, Vol. 32 (1986), pp. 1492–1512.
19. M. Lea, T. O'Shea, P. Fung and R. Spears, "'Flaming' in Computer-Mediated Communication: An experiment on Synchronous Terminal-to-Terminal Discussion," in M. Lea (ed.) *Contexts of Computer Mediated Communication* (Hempstead: Harvester, 1992).
20. L. Spears and M. Lea, "Social Influence and the Influence of the 'Social' in Computer-Mediated Communication," in M. Lea (ed.) *Contexts of Computer Mediated Communication* (Hempstead: Harvester, 1992).
21. L. A. Lievrouw, "Four Programs of Scientific Communication Research," *Knowledge in Society*, Vol. 1, no. 2 (1998b).
22. K. Carley with K. Wendt, "Electronic Mail and Scientific Communication: A Study of the Soar Extended Research Group," *Knowledge: Creation, Diffusion, Utilization*, Vol. 12, no. 4 (1991), pp. 406–440.
23. R. E. Rice, "The Impacts of Computer-Mediated Organizational and Interpersonal Communication," in M. Williams (ed.), *Annual Review of Information Science, Vol. 15* (White Plains, NY: Knowledge Industry Publications, 1980).
24. E. B. Kerr and S. R. Hiltz, *Computer-Mediated Communication Systems* (New York, NY: Academic Press, 1982).
25. J. W. Tombaugh, "Evaluation of International Scientific Computer-Based Conferences," *Journal of Social Issues*, Vol. 40, no. 3, (1984), pp. 129–144.
26. J. Lanier and F. Biocca, "An Insider's View of the Future of Virtual Reality," *Journal of Communication*, Vol. 42, no. 4 (1992), pp. 150–172.
27. D. Kaufer and K. M. Carley, *Communication at a Distance: The Effects of Print on Socio-cultural Organization and Change* (Hillsdale, NJ: Lawrence Erlbaum Associates, 1993).
28. K. Carley, "Communication Technologies and Their Effect on Cultural Homogeneity, Consensus, and the Diffusion of New Ideas," *Sociological Perspectives*, Vol. 38, no. 4 (1995), pp. 547–571.
29. P. N. Bloom and T. Reve, "Transmitting Signals to Consumers for Competitive Advantage," *Business Horizons*, Vol. 33, no. 4 (1990), pp. 58–66.
30. S. C. Schneider, "Information Overload: Causes and Consequences," *Human Systems Management*, Vol. 7, no. 2 (1987), pp. 143–153.
31. H. B. Becker, "Can Users Really Absorb Data at Today's Rates? Tomorrow's?," *Data Communications*, Vol. 15, no. 8 (1986), pp. 177–193.
32. M. Hahn, R. Lawson and Young Gyu Lee, "The Effects of Time Pressure and Information Load on Decision Quality," *Psychology and Marketing*, Vol. 9, no. 5 (1992), pp. 365–378.
33. E. Iselin, "The Impact of Information Diversity on Information Overload Effects in Unstructured Managerial Decision Making," *Journal of Information Science Principles and Practice*, Vol. 15, no. 3 (1989), pp. 163–173.
34. E. J. Muller, "Information Overload," *Distribution*, Vol. 90, no. 4 (1991), pp. 26–32.
35. R. E. Rice and D. Case, "Electronic Message Systems in the University: A Description of Use and Utility," *Journal of Communication*, Vol. 33 (1983), pp. 131–152.
36. R. L. Enos (ed.), *Oral and Written Communication: Historical Approaches* (Newbury Park: Sage, 1990).

37. J. Goody, *The Logic of Writing and the Organization of Society* (Cambridge: Cambridge University Press, 1986).
38. E. L. Eisenstein, *The Printing Press as an Agent of Change Communications and Cultural Transformations in Early Modern Europe; 2 Vols* (London: Cambridge University Press, 1979).
39. H. Innis, *The Bias of Communication* (Toronto: University of Toronto Press, 1951).
40. I. del Sola Poole (ed), *The Social Impact of the Telephone* (Cambridge, MA: MIT Press, 1977).
41. L. D. Reynolds and N. G. Wilson, *Scribes and Scholars: A Guide to the Transmission of Greek and Latin Literature* (Oxford: Clarendon Press, 1968).
42. L. A. Lievrouw, *The Communication Network as Interpretive Environment: "Sense-Making" Among Biomedical Research Scientists*. Unpublished Ph.D. dissertation, Annenberg School of Communications (Los Angeles, CA: University of Southern California, 1986).
43. L. A. Lievrouw and K. Carley, "Changing Patterns of Communication Among Scientists In an Era of Telescience," *Technology in Society*, Vol. 12, no. 4 (1990), pp. 457–477.
44. E. M. Rogers, *Diffusion of Innovations* (New York, NY: Free Press, 1983).
45. M. Weenig, W. H. Midden and J. H Cees, "Communication Network Influences on Information Diffusion and Persuasion," *Journal of Personality and Social Psychology*, Vol. 61, no. 5 (1991), pp. 734-742.
46. B. Thorngen, "Silent Actors: Communication Networks for Development," in I. del Sola Pool (ed.), *The Social Impact of the Telephone* (Cambridge, MA: MIT Press, 1977).
47. B. Bledstein, *The Culture of Professionalism* (New York: Norton, 1976).
48. K. M. Carley, "Group Stability: A Socio-Cognitive Approach," in E. Lawler, B. Markovsky, C. Ridgeway and H. Walker (eds.) *Advances in Group Processes* (Greenwich, CT: JAI, 1990), Vol. 7, pp. 1–44.
49. K. M. Carley, "A Theory of Group Stability," *American Sociological Review*, Vol. 56 (1991a), pp. 331-354.
50. D. Kaufer and K. Carley, "Some Concepts and Axioms about Communication: Proximate and at a Distance," *Written Communication*, Vol. 11, no. 1 (1994), pp. 8–42.
51. W. Gantz, K. A. Krendl and S. R. Robertson, "Diffusion of a Proximate News Event," *Journalism Quarterly*, Vol. 63, no. 2 (1986), pp. 282-287.
52. P. Huber, "Silicon on the Bell Curve," *Forbes*, Vol. 154 no. 12 (1994), p. 210.
53. D. C. Barnlund and D. Harland, "Propinquity and prestige as determinants of communication networks," *Sociometry*, Vol. 26 (1963), pp. 466–479.
54. D. G. Altenpohl and U. Lohmar, "'Informatization' of Industry and Society: The Third Industrial Revolution," *International Journal of Technology Management*, Vol. 3/4 (1986), pp. 327-340.