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AUTHOR	Raman, Usha
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ABSTRACT

New technologies of communication and information representation have almost always had an impact on the conduct of social and organizational life, sometimes creating new linkages, strengthening some existing ones and breaking others. Science operates within a technological environment which itself is a product of social, cultural, economic and political factors. Using in-depth interviews with members of a department of anthropology (faculty, technical support staff, and graduate students) who have recently been introduced to a new technology, Geographic Information Systems, a study examined issues of communication and community building in relation to knowledge production. Results indicated that (1) anthropologists do not explicitly acknowledge the importance of technology in the production of science; and (2) what scientists talk about may be less important than who they talk to--and this is often determined by methodological rather than conceptual alliances. (Contains 56 references.) (Author/RS)

Communication, Technology, and the Formation of Scientific Communities

Usha Raman
Doctoral Candidate
College of Journalism and Mass Communication
University of Georgia
Athens, GA 30602
Tel: 706-542-5092 (O)
706-613-2829 (H)
email: uraman@uga.cc.uga.edu

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Abstract

New technologies of communication and information representation have almost always had an impact on the conduct of social and organizational life, sometimes creating new linkages, strengthening some existing ones and breaking others. Science operates within a technological environment which itself is a product of social, cultural, economic and political factors. Using in-depth interviews with anthropologists who have recently been introduced to a new technology, Geographic Information Systems, this paper examines issues of communication and community building in relation to knowledge production.

Communication, Technology and the Formation of Scientific Communities

Introduction

Every new communication technology, from the telegraph to the computer, has had an impact on the conduct of social and organizational life (Marvin, 1988). Technology has the power to bridge and create distances, open doors to some and close avenues to others. Our worlds are, in many ways, limited by the technologies we are surrounded by. The information that we have access to depends on how many and what kinds of television channels we can view, the libraries (both physical and virtual) we have entry to, and the linkages we forge and maintain with individuals and groups through telephone and other electronic connections. We see as much and as far and as well as our radio telescopes and satellite images allow us to, and make sense of information in ways that our sciences legitimize.

While social groups of all kinds can be defined by their communicative links, scientific communities are particularly recognizable by the extent and nature of these linkages. Scientists--as do other social subgroups--exist within communication. The body of knowledge that a group accepts as "scientific" is the product of consensus, which again is achieved by communication. Such a group communicates through the use of common linguistic and other symbols, and applies similar methods to the manipulation and presentation of information. The technologies applied to the handling of information form an integral part of the communication matrix within which a scientific group operates. I propose that information technologies may influence the way science is done, the way science is communicated within and outside a scientific group, and the manner in which collaborative links are formed.

Constructivist approaches to science describe scientific products as being "selectively carved out, transformed, and constructed from what is" (Knorr-Cetina, 1981). And "what is" includes laboratory instrumentation, consensually acquired methodological tools, information technologies--in short, all the paraphernalia that surround the actual process of science. By the time a scientist articulates a research problem, operationalizes it, gathers data in accordance with this operationalization, and processes the data, the problem has already been through a variety of translations, and has been communicated in a variety of ways to different people within the research group (or in the audience).

Derek de Solla Price holds that experimental art and craft provide "an exogenous force that moves science rather than does its bidding" (Price, 1986). If experimental techniques and methods can influence the way science moves, it would seem that information manipulation and presentation technologies may also influence scientific activity. The medium that is employed to convey information--to house meaning--is as much a moderator of communication as are other contextual factors.

The structure of science has been studied more often from a sociological and philosophical perspective than it has from a communication perspective. As Laudan notes, philosophers and sociologists of science emphasize the consensual nature of science and are often preoccupied with explaining this consensus. The mechanism by which consensus is achieved or, more importantly, the means by which disagreements are resolved, are rarely dwelt upon (Laudan, 1984). However, if communication defines and sustains a scientific group, it is not only possible but imperative to study the patterns of communication and idea flow in science.

The introduction of new technologies, of new methods of doing science, necessarily involves the introduction of "outsiders," experts in technology, into a particular area. These outsiders may be conversant with the technology itself but are new to the discipline into which it is being introduced. This necessitates new communication links that might require the use of further "translation" (Knorr-Cetina, 1981) of symbols familiar to one discipline into terms that are familiar to the newcomers.

This paper, which describes a study in progress, as a first step aims to bring together the perspectives on scientific change that reside in different areas, particularly with regard to the influence of technology on scientific growth and the influence of formal and informal communication on scientific growth. Our era is one in which access to technology determines access to information, and ability to communicate about that information or with others who use that technology. Information technology is important, therefore, not only in and of itself, but also because it often marks the limits of knowledge growth and movement, sometimes more in some disciplines than in others.

As a second step, perhaps more importantly, the work in progress aims to investigate the process of scientific growth from a communication perspective. Several models of scientific change have been developed by sociologists and historians of science, but the process of this change presents at best a hazy and ambiguous picture. Communication is the essence of this process--communication both within and outside a particular science. Within the science, communication drives the transformation, testing and ultimate acceptance of ideas. Outside the science, it molds public perceptions and facilitates assimilation into the larger world view.

In the same way that it is important for us as communications scholars to understand how organizations and communities grow and change, it is important to understand the factors that determine or influence growth and change in science.

The basic assumption here is that science operates within a technological environment which is itself a product of social, cultural, economic and political factors. The reasons for the adoption of a technology or a method of inquiry, for that matter, are never purely scientific. Communication about a technology influences its adoption, and communication as a result of this adoption influences the science itself.

The discussion that follows represents in a part a preliminary analysis of a subset of interviews conducted with social scientists at a major southern university. The bulk of the paper will synthesize the literature on the topic, following which the participants' views are presented and a tentative framework proposed for the way in which technology impacts communication in science.

A Brief Note on Method and Context

A basic premise of this study is that science is a social construction, and its nature is determined by those who "do science." They are, moreover, seen as "doing science" by others in the community. As such, the main source of data are members of a scientific group, and the artifacts of the process of doing science. One of the main criticisms against studies of scientific communication is that they have focused too long and too much on the structural aspects of scientific communities. Lievrouw criticizes what has long been considered a seminal study of scientific communication, Diana Crane's Invisible Colleges (Crane, 1972) for obscuring "the central role of communication behavior and interpersonal processes" while emphasizing the mapping of institutional structure (Lievrouw, 1989). Knorr-Cetina insists that, in order to understand the process of science, rather than just its structure, we must "listen to the talk about what happens, the asides and the curses, the ... formal discussions and the lunchtime chats." (Knorr-Cetina, 1981) The intention in this study is to attempt to capture this process.

Within a university environment, departmental or laboratory affiliation is considered a mark of identity. For the purposes of this study, a scientific group is a group that identifies itself as part of a particular academic discipline, following a certain path of inquiry. Preliminary inquiries revealed that the anthropology department at a major southern university had recently acquired a GIS lab, among other new facilities.

GIS represents a particularly interesting information technology because it is used by a variety of professionals within and outside academe. The GIS uses computers to manage data tied to geographic locations, such as distributions of various kinds, movements and trends; the data is represented in the form of a multilayered "map."

I interviewed at length members of the department of anthropology, i.e., faculty, technical support staff, and graduate students; scrutinized paperwork relating to the acquisition of the GIS lab and its use and looked at research proposals and reports prepared by the department. The purpose was to build as complete a picture as possible of the communicative processes that led to and were generated by the presence of the new technology.

Like any tool that helps us communicate--graphs, charts, tables, pictures or icons--GIS has acquired its own grammatical and syntactic apparatus that links its users. By choosing to use GIS or any such communication tool, it is proposed, researchers adopt that grammar and syntax. The questions they ask, the way in which these questions are asked, and the answers that are accepted all are structured within this set of rules. The existence and use of this "language" is what defines the community of users.

GIS is an information representation and manipulation technology--and information representation and manipulation are what communication is all about. What we are looking at here is communication as the act of creating and representing information, and the impact this has on community creation.

Communication studies, particularly in mass communication, have focused primarily on the construction of messages and their impact on audiences. This study, instead, focuses on the tools used to create these messages, and the impact this act of creation has on the message itself. What we communicate is as much constrained by the physical features of the communicative setting (media or instruments) as it is by the psychological and social features (the cognitive tools). As such, it is just as important to study the tools we use to construct our messages and imbue them with meaning as it is to study the messages themselves.

The Nature of Science

Since Aristotle and perhaps even before, science--or natural philosophy--has been the focus of attention of academic discussion. After the scientific revolution of the seventeenth century, it became not only fashionable but also, in many ways, imperative, to study the institution that science was becoming and to posit theories about its growth. Until the beginning of this century, the premise, common to philosophers and sociologists, was that science is culturally unique and is to be distinguished from other intellectual pursuits (Laudan, 1984). Twentieth century philosophers and historians of science (Kuhn, Hanson, Feyerabend) established the idea that science was not impervious to the cultural and social influences of its time.

The debate about science and non-science lies outside the scope of this essay; for our purposes, "science" refers to any body of knowledge and tradition of inquiry that follows systematized procedures. The word "science" is thought to have entered the English language around the Middle Ages (Goldsmith, 1986) from France, where it was at the time considered synonymous with "knowledge." The early Latin translators of Aristotle gave the adjective "scientificus" a technical interpretation meaning "systematized and accurate knowledge" (Goldsmith, 1986). Reynolds defines science as providing a method of organizing facts with a view to explaining, understanding and predicting phenomena (Reynolds, 1981). Consequently, most scientific and social scientific disciplines in the academy would be considered producers of "science."

The Structure and Formation of Scientific Communities

Thomas Kuhn defines a scientific community as a group of people who share a paradigm, or a system of beliefs about the world (Kuhn, 1970). The paradigm determines the tools and techniques the group uses, the literature it cites, the questions it asks and the means by which answers are arrived at and ultimately structured. The scientific community that a scientist inhabits is part of a larger social world (Unruh, 1980), which is a form of social organization that cannot be accurately delineated by spatial, territorial, formal or membership boundaries. The social world therefore encompasses the invisible college (Price, 1963; Crane, 1972), occupational contact networks and subcultures.

Sociological studies of science tend to follow one of two main approaches (Lohdahl & Gordon, 1972) ; one stream focuses on the normative aspects of science (Cole & Cole, 1973; Gaston, 1972; Lan et.al. 1988), while the second focuses on organizational structures and processes that drive science (Knorr-Cetina, 1981). The first stream is exemplified by the empirical, largely quantitative studies of Derek de Solla Price and Robert K. Merton, and the second is concerned with the local, largely extra-scientific contexts within which knowledge is produced (Ben-David, 1991). Both streams together draw a picture of science as a social system whose rewards are based as much on productivity as on other contextual factors. Griffith describes Merton's pioneering work on communication and social processes in science as providing the "Laws of Rugby" for science (Griffith, 1989). The sociological theses of Merton (Merton, 1942) and Hagstrom (1965, cited in Griffith, 1989) were in many ways paralleled in the philosophical writings of Kuhn (1962, 1970) and Polanyi (1958, cited in Griffith, 1989). Empirical work in the area, after Merton, was taken up by scholars such as Derek de Solla Price, Diana Crane, Mullins and others (Griffith, 1989). Although these studies were not ostensibly seen as communication studies, they used as data the artifacts of science--communication products and linkages.

Studies of this kind often use citation measure of some sort to "map" the structure of scientific fields. Lan et. al. (1988), for instance, used co-word analysis of research into environmental acidification, in order to discern the role of texts in scientific inquiry. Cole & Cole (1973), in a study of university physicists, seeking to determine whether the stratification of individuals in science was based on the quality of scientific performance and whether a discrimination obtained in the process of status attainment, found that the scientist who is strategically located in the stratification system may have a series of advantages over one who is not a member of the "elite corps" (Cole & Cole, 1973). Despite this, they concluded that a high level of universalism existed in science. However, those who study the social context of knowledge production such as Karin Knorr-Cetina and Barry Barnes argue that science is not as egalitarian as it appears to be. Scientific achievement and the rewards that it brings, depend to a great extent on where you are in the hierarchy, what equipment you are allowed to handle, and what avenues of publication you are able to pursue. These are what Knorr-Cetina calls "contextual contingencies" (Knorr-Cetina, 1981). This is also, in essence, the social constructionist perspective of science, which argues that all outcomes in the sciences are negotiated and that social interests are involved in the negotiation of technical outcomes (Longino, 1990). Shapere also emphasizes that there are factors both internal and external to science that affect its development (Shapere, 1987).

If science is considered no different from any other branch of inquiry, it follows then that those carrying out scientific research are engaging in an activity that is in its essence social. Bly, Harrison & Irwin (1993), in a study of "media spaces" (work environments that allow geographically remote groups to interact in real-time) found that most work is fundamentally social, "constructed out of the activities of the participants and those activities depend on more than the explicit content of the work task." Pinch, in a comparison of several studies in the sociology of science, demonstrated that scientific outcomes are not always the result of a well-devised research program, but depends on the scientific community (Pinch, 1990). In Longino's words, "The points of contact with the social and cultural context determine to what areas the rules will be applied,... which practical applications of knowledge will be pursued... and which paths to knowledge will be followed." (Longino, 1990, p.85.)

How this social system comes to be is hypothesized to follow a step-wise process (Crane, in Crawford, 1971) that begins with an amorphous, loosely connection group and grows into an invisible college of adherents to a research paradigm. The more power one has in such a network or in an invisible college, the easier it is "to select the best students, tap the biggest funds, cause the mightiest projects to come into existence" (Price, 1986, p.99). Ben-David (1991) adds that ideas are not "self generating," and must be implanted in some special way in the scientist's social network if they are to give rise to new ideas and systems of thought. Needless to say, all the activities that lead to the acquisition and exercise of power and influence are effected through communication.

Communication and Collaboration in Science

Science grows and develops in a climate of unhindered exchange of ideas, and the nature of this scientific discourse often determines the direction scientific growth takes. It has been observed that science is much more competitive than even athletics or business, and because of its relative objectivity, impersonality, cumulative nature and relative certainty, very quick and highly credible judgements are possible (Crawford, 1971). Consequently, to remain competitive, it is important for scientists to have access to the latest information, both in terms of ideas and procedures. It is also essential that they communicate in order to maintain collaborative, cooperative or instrumental linkages with others in their community.

Cole & Cole note that communication is "the nervous system of science, the system that receives and transmits stimuli to its various parts." (Cole & Cole, 1973, p.16). Recognition is conditional upon the visibility of scientific work, which in turn is dependent on efficient communication. Freudenthal, in a foreword to a volume of Ben-David's work, remarks that it is "the social anchoring of the intellectual innovation... that assures its survival." (in Ben-David, 1991, p. 31.)

In most areas, scientific activity depends on information from a variety of sources: ideas feed upon ideas and become accepted concepts only if they are corroborated by a number of independent researchers. Sociologists of science often describe three stages of scientific endeavor: (1) planning, (2) information collection and analysis, and (3) dissemination of results and their acceptance into the greater body of knowledge (Borden, 1992). At each stage, the communication needs are different and are met in different ways.

Citation measures of scientific publications bear out the existence of closely connected, strong relationships among opinion leaders within disciplines (Price, in Nelson and Pollock, 1970). Price, in fact, goes so far as to call this network a "conspiracy :"

> "...essentially, scholarship is a conspiracy to pool the capabilities of many men, and science is an even more radical conspiracy that structures this pooling so that the totality of this sort of knowledge can grow more rapidly than any individual can move by himself."

Beniger (in Aborn, 1988) says that researchers exploit information produced by others whose help they formally acknowledge in return, thereby distributing authority and status among a few leadership roles.

Science, then, can be seen as a large social system that spans national and cultural spaces with its representatives connected by a variety of communication links--links that are responsible for the flow of ideas and information, or for conferring recognition and acceptance. Communication is important both within the system, to generate ideas and further the discipline, and outside the system, to generate resources for research, to promote the results of science to the general public, to gain acceptance into the larger body of public knowledge, and to realize the social gains from science in the form of technology, medicine, etc.

Lievrouw (1990) proposes that the scientific "communication cycle" follows three stages: conceptualization, documentation and popularization. It is important to note, however, that not all scientific ideas become popularized; most of the time, they are developed in a process that moves back and forth between conceptualization and documentation. As far as scientific activity goes, the first two stages are perhaps more important than the third. It is in these stages that scientists decide which research paths to follow and which to pass by, what method to apply, and how to interpret the results.

Studies of communication in science too, like social studies of science, have emphasized the structural aspects of community as evidenced by communication. Lan et. al. (1988) defend citation analysis, which is by far the most common tool applied to study the structure of scientific communities and their communication links: "[T]though scientists do much more than simply write papers and reports, the activity of writing and publishing is both central to their work and represents a reasonable record of the 'public face' of science." However, to focus purely on the structural is to ignore the process that builds that structure. As Laudan notes:

> "Students of the development of science, whether sociologists or philosophers, have alternately been preoccupied with explaining consensus in science or with highlighting disagreement and divergence." (Laudan, 1984, p.3.)

Laudan goes on to say that the problem of consensus formation is essentially a problem of the dynamics of convergent belief change. Few studies, however, investigate the dynamics of this process. In a related discussion, Van-Rossum (1973) describes informal communication among scientists as providing a significant path to understanding the development of scientific fields. Gaston in an investigation of a group of high-energy physicists in Great Britain found that while publications did play an important role in information transfer, verbal contacts were considered to be the most important method of obtaining information relevant to research (Gaston, 1972). Personality and professional standing were important modifying variables in the study, as one might expect if science is seen as a complex social system. Even where informal groups do not achieve the status or the size of an invisible college, such networks are still seen as providing instrumental support to research activity (Lawson, 1992).

Pan & McLeod (1991) note that when studying communication processes in any community or group, micro-social theories such as coorientation, symbolic interactionism, role theories, etc., can provide the language for us to think and talk about linkages. This becomes particularly important in scientific communities where collaborative or cooperative linkages are so crucial to the flow and development of ideas and the growth of fields. Borden (1992) notes that collaborations can be a matter of choice or a necessity and that personality and institutional characteristics will play a role in their formation and success. In another context, Salmon suggests that communication researchers should focus on the integrative uses of communication (Salmon, 1989), a suggestion that is as applicable to the study of scientific communities as to any other. With communication becoming increasingly mediated and moderated by various factors, not the least of which is technology of various kinds, this integrative function becomes particularly important.

Enter New Technologies

The traditional vehicles of communication among scientists--professional and trade journals, conferences and academic symposia-have now been augmented and in some cases even supplanted by new communication media, primarily computer-based instruments and networks. This is particularly true in Western industrialized nations, where computer-communication technologies have become more than commonplace. The imposition of these new technologies has in its own way affected the nature of communication and,perhaps, the nature of science itself. Aborn (1988) comments: "Science is on the verge of being transformed by one of its own prodigies--information technology." In the late 1980s, NASA adopted the term "telescience" to describe the manner of scientific research carried out remotely via computer-based networks, involving collaboration between scientists far removed from each other and often from their physical facilities (Watkins, 1994).

Beniger (in Aborn, 1988) describes the convergence of information processing and communication technologies as extremely important in terms of its impact on science as a social system. Scientists, increasingly, are engaging in networking, i.e., using computers as mechanisms for the exchange of data (Kranzberg, in Aborn, 1988). The Human Genome Project is one example of scientists in many locations working on a joint project, sharing data and results and attempting to put together a gigantic jigsaw puzzle on one computer table. Another "collaboratory" (a collaborative laboratory project) recently initiated involves space scientists all over the world accessing data from instruments located near the Arctic Circle (Watkins, 1994). Medical researchers routinely share data generated by expensive equipment that is found at only a few locations, as do high-energy physicists.

Media richness theory (Schmitz and Fulk, 1991; Hunter and Allen, 1992) predicts that electronic means of communication such as e-mail rate high among researchers for ease of use and utility, coming very close to interpersonal interaction. Media richness refers to the extent to which media are able to bridge different frames of reference, reduce uncertainty, and provide feedback (Rice, 1993). In a study of computer mediated communication and organizational innovation, for instance, Rice found that the characteristics of the technology had the potential to enhance certain kinds of interpersonal interactions, and ultimately, impact innovativeness within organizations.

Visual computing technology has enhanced the ability of scientists to communicate various types of information in an easily accessible form both to their peers and to outsiders. This has particular implications for the "public relations" aspect of science--obtaining grants, popularizing results, gaining social recognition, etc. (King, 1994; Lievrouw, 1992).

Most researchers describe the advantages of the new information technologies to science, recognizing that "Inasmuch as information exchange is a vital part of the scientific and engineering professions, these electronic capabilities greatly enlarge the possibility of scientific and technical advance" (Kranzberg, in Aborn, 1988). However, the imposition of expensive (and therefore not universally accessible) technology has created a new set of haves and have-nots in the international scientific community. Gillespie and Robins (1989) argue that new communication technologies create new and enhanced forms of inequality. Rather than redistributing resources far and wide, as they appear to , these technologies actually tend to increase the power of the center. Davenport, Eccles and Prusak (1992) hold that information technology has made information and access to it so valuable that it has created a new sort of politics. Information is almost a currency that the privileged trade in. Those that do not have the same concentration of information resources are more likely to be marginalized in a number of areas, and science, being so information-intensive an activity, is an area of major concern (Gerbner, Mowlana and Nordenstreng, 1993).

Within organizations, technologies such as e-mail and voice mail change individuals' perception of and participation in the communication process in terms of scope, patterns and message content (Adams, Todd & Nelson, 1993). In an earlier discussion, Marvin commented that, "Old habits of transacting between groups are projected onto new technologies that alter, or seem to alter, critical social distances. ...Media are not fixed natural objects... They are constructed complexes of habits, beliefs and procedures embedded in elaborated cultural codes of communication." (Marvin, 1988, p.4, p.8.) In her discussion of the contextual nature of science, Longino observes, "Any science must characterize its subject matter at the outset in ways that make certain kinds of explanation appropriate and others inappropriate. This characterization occurs in the very framing of questions." (Longino, 1990, p.98.)

Taken together, these statements would imply that new technologies can impact science and communication in science in ways that not only affect social relations among its members, but also the character and mores of the science itself. Of course, technological determinists such as McLuhan and to some extent Derek de Solla Price reiterate the belief that the "arrow of causality is largely from the technology to the science," and that "the changes in paradigm that accompany great and revolutionary changes [are]...due to the application of technology to science." (Price, 1986, p.247.) In a somewhat different sense, Knorr-Cetina stresses the importance of the technological context within which science is "constructed." Selections made by scientists in the laboratory, according to her thesis, are not only "decision impregnated," but also "decision-impregnating" (Knorr-Cetina, 1981). In other words, the nature of the technology predisposes the scientist to certain selections, makes some choices more appropriate than others, and plays an important role in the construction of scientific products.

While Connors notes in The Race to the Intelligent State , that technology is the most predictable element of the world's information infrastructure, he adds a simultaneous disclaimer: "...the general pattern of technological change can be predicted more easily than its outcome" (Connors, 1993, p. 187). This of course has not stopped the pundits from predicting some sort of social impact. Sproull & Keisler (1991), for instance, provide a two-level perspective of the effects of computer-communications. The first level has to do with the anticipated or potential efficacy of the technology itself, and the second, with the effects on the social system using the technology. Jacques Ellul, the noted French sociologist, observed that all technological innovations have unforeseeable effects, of which the positive and negative are often inseparable (quoted in Dizard, 1985).

McKearney, in a doctoral study of the uses and impacts of computer-mediated communication among faculty in mass communication and related disciplines, concluded that the communication functions of computer networks are more important than the information functions

(McKearney, 1995). This implies that the community-building nature of communication technology should not be underestimated. As Trevor Haywood notes, "It is possible that much contemporary information access and exchange has as much to do with habit, ritual and oneupmanship as it does with real needs. Whether social or antisocial, the transaction has become as important as the outcome." (Haywood, 1995, p.242.)

In contrast, Connor (1994) states that the material circumstances involves in the communication process affect and are affected by the physical capacities of the communication media and the capabilities of its participants. Rather than simply being a function of habit, a change in material circumstance will involve a change in the manner and form of communication. Computer-based technologies have a particularly important role to play in the way scientific communities grow and operate, as they enable all sorts of multilateral flows of information, making the functioning of invisible colleges and visible meetings easier (Pool, 1990). A national report on "collaboratories" noted that while "technology will never cause the unwilling to collaborate, it can facilitate collaboration among those who are motivated and can also make it attractive to others." (National Academy Press, 1993.)

Facilitating groups is not the only impact new technologies can have. Warnat, based on a study of automation in the engineering industry, concluded that society is being further stratified into the "knowledge people," those that are able to adapt to the new technology and do, and those that either choose not to or are unable to (Warnat, 1983). As Deetz notes, no technology is ever politically (or socially) neutral. "Technological developments give preference to forms of expression and thought, some of which reflect a group's actual interests and thus enable individuals to represent them in public forums." (Deetz, 1990, p.49.) The inherently political nature of technology is something that is not given much critical attention in academic circles outside technology studies, although most current analyses of scientific and technological issues are critical, often radical (Pena, 1992). In a theoretical discussion of the impact of information technology, Davenport, Eccles & Prusak (1992) observed that the technology, instead of eliminating hierarchy and facilitating information flow, has created a politics of information. Groups and individuals withhold or strategically release information to achieve their own goals. The way in which this information flow is regulated by scientists may initiate a dynamic of its own, altering the composition of groups and their interrelationships. Ben-David predicts that with the introduction of new technologies, scientific progress may entail the splitting up of a more or less homogeneous community into a "confederation of overlapping sub-communities" Ben-David, 1991). Although most scientific subgroups are in theory relatively open, access to technology or user capability may effectively limit group membership.

Apart from privileging certain forms of information and its representation, communication technology is also posited to have an impact on the very process of communication. Elena Esposito writes that the "increasingly sophisticated technologies... have created communication that is increasingly abstract from a context and independent of the event of utterance" (Esposito, 1993). An interview-based study of artists and musicians using new communication technologies found that there were radical structural changes in conventional processes of cognition, knowledge-acquisition and utilization (Lacroix, 1992).

The rest of this paper attempts to describe what impact the introduction of GIS has, and is having, on the nature of communication and community-formation among anthropologists.

Talking about Technology

Conversations with the participants explored their ideas about communication with peers and the public, the role of technology in their research and in developing and maintaining working links, their perceptions of their work in relation to the discipline and the nature of changes over the years in anthropology. While these areas are diverse, the hope is that when the study is completed, it will tie together concepts in a manner that provides insight into the ways in which communication processes influence scientific activity, or knowledge production.

I have restricted this preliminary analysis to the participants' comments about Geographic Information Systems and other information management technologies. The eight tape-recorded interviews that are considered here were transcribed and the transcripts read carefully to identify themes within each interview and then, for commonalities across all eight interviews. The analysis is inductive, in that theoretical categories are derived from the data (Lincoln & Guba, 1985). It most closely approximates Glaser & Strauss' (1967) method of constant comparative analysis. Each interview informed and shaped the next, as questions were constantly refined and focused.

A paper of this length cannot completely capture the complexities and nuances of the conversations; that depth and detail and a truly "thick description" (Geertz, 1973) must be reserved for a more exhaustive discussion. However, by focussing on only one (or two or three, perhaps) of the threads that meandered through the long conversations, I hope I will be able to provide some indication of the extra-scientific context, of communication and its apparatus, that anthropologists work within.

As mentioned earlier in this paper, the GIS laboratory in the department of anthropology was set up in 1993. The new department head, who was a strong advocate of the technology, hoped that it would become "the heartbeat" of the department's research activities. The lab started with 12 users logging on for a total of 103 hours in the first quarter, and now averages about 25-30 logins per day.It is not clear how much of this reflects actual use of the technology for research. Only two of the participants have incorporated GIS into on-going research projects, all the others are only considering its use or just learning about it. According to the systems manager (a technical support person, referred to here as KJ), most of the recorded logins are by graduate students learning GIS applications. The department periodically holds non-credit seminars designed to encourage GIS use among new graduate students and faculty. It must be recognized here that the majority of the participants, when talking about GIS use, are talking about how they think it might impact their work or why it does not.

The anthropologists (or anthropologists-in-the-making) I spoke with represent a wide range of specializations and sub-fields within the discipline. Their level of technology use varies because of this, as well as due to personal styles of doing work. Archaeology, as a sub-discipline, tends to be more technology (or instrumentation) intensive than, for instance, cultural anthropology. While I do not venture to make any predictions or judgments of technology adoption based on this, I think it may well be a factor that predisposes the scientist one way or another. Anthropologists are also particularly sensitive to the post-modern critiques of science and knowledge construction, and their responses may tend to reflect this. Curiously enough, though, they seem to use this self-proclaimed sensitivity almost as armor in the face of suggesting that their methods of knowledge creation are as contextually delimited as are any others'.

Deconstructing the "Toolbox"

Within this context, it is not surprising that most of the participants are quick to say that to them, GIS represented no more than a tool. "It's just another tool in the toolbox," says KS, a senior archaeologist who has used GIS and similar spatial technologies to organize information. He emphasizes that it "is not a new idea language by any means." "It's just a tool...it facilitates communication but does not necessarily make or break it," says GT, a relatively young assistant professor who is described by many in the department as an adept user of information technologies. However, it is also a tool that allows GT

> "to ask questions that people have had for a long time but have found very difficult to approach.[I]n a sense, yes, it does allow me to talk about different things...and certainly GIS --it's dealing with a dimension of social phenomena that is very difficult to grasp outside the medium of cartography. You can describe, much like we are doing...you sit down and tell me about the space, and you can...present it textually, and a lot of people have done that. But space is three dimensional and the two dimensional word doesn't quite do it justice."

GT agrees that new information management technologies like GIS make it possible to "expand the explanations" that are sought, by, it would seem, expanding the dimensions along which information can be represented. Or, as KJ, the systems administrator put it, "At a glance you can see a space which you cannot create in your mind." It is, to him, a different way of seeing, something that archaeologist HJ echoes: "It's a new way of looking at and handling data...it expands the range of the problem you may be looking at." HJ recently used GIS in an rather unusual manner, to look at patterns of burials across a large archaeological site.

"It's hard to envision how I would have done this without the GIS. I think I'm much more attuned to looking for repetition, for patterns, and then looking for variations on those patterns, much more than I would have been prior to GIS."

Participant BE, agrees, saying, "It allows you to look at things in a kind of different way than you might have." BE has worked with others who have used the technology but she herself has not applied it. LB, a cultural anthropologist who recently made shifted his research focus, is careful not to overemphasize the importance of technological inputs while agreeing that changes do ensue from them:

> "It's not that the technology drive its, but the technology opens up a whole range of possible questions that the researcher may not have been able to deal with otherwise. Yes, it clearly expands the horizons of the research field. Technology makes more answers possible."

By making more answers possible, it "enriches [the research arena], it changes the questions, perhaps...it changes some of our activities, for some of us, in the discipline." (KS) Clearly, then, GIS may be a tool, but it is one that fashions the user's message even while the user fashions messages with it.

The Visual Gestalt

A GIS rendition of information, according to GT, causes a "visual gestalt" in the viewer, by locating ideas and information in a graphic space. While this certainly adds to the persuasive nature of the communication, particularly for lay or generalist audiences, it also does something to the way the communicator approaches the information. For HJ, GIS makes it possible to "Think big," and for BE, "bigger projects feasible."

> "With big field maps...they're just too cumbersome--there's just no way you could look at a whole site, a whole community, with just those. So being able to reduce those things down, in this GIS program, to a map like

> that...and I can focus in on that, you know, expand it, work in any scale you want...I don't know how I would have done this without GIS." (HJ)

By reducing the difficulty and expanding the scale and range of view, the GIS representation allows HJ to expand his own vision:

> "...now I'm thinking more and more, while I'm doing it, I mean, why fool around, just going halfway on this, let's bring in environmental variables as well, that will be useful in understanding these clusters...and so on."

Speed and convenience are a means to seeing more with GIS, according to KS:

> "If you can manipulate the spatial data more then you can play with it more. You do more analysis simply because it's going to take you a day instead of a month. And added to that it also gives you a little more analytical freedom....It's also easier to visualize [analytical models] if they have some spatial dimension. And I think that has--these sort of graphic or visual models may sharpen our thinking."

The sharpened thinking leads KS to make "much stronger causal or explanatory propositions" than he had in the past. This apparently is a result of being able to deal with more details across a broader range; so, GIS representations make it possible, in a manner of speaking, to focus in and use a wide angle lens at the same time.

Building New Bridges

> "I can see where the greater power of this approach to analyze may raise questions that would require an outsider to answer--you know, somebody with biological expertise--you may have to go back to that person, saying, you know, 'I've noticed this...'" (HJ)

There is no way a scientist in any discipline can look at a larger canvas than he or she is accustomed to and see and explain everything that is portrayed there. One either has to acquire new information and educate oneself, or be educated by others already knowledgeable in these areas. That is exactly what the anthropologists who use GIS are experiencing. Of course, in many cases the collaborative links had been forged before GIS was introduced, but in some cases the presence of the technology necessitates collaboration. KS describes how use of the technology has changed his research relationships:

> "This may sound odd, but I feel more of an intellectual kinship now with people like historians than I have before, because I now have ways of seeing how what were previously incongruent bodies of data might be put together in some meaningful way."

He goes on to describe a particular project in which he organized historical data in a spatial framework, and then, he could "read it in a new way." BE and NV, a cultural anthropologist, talk about other information technologies such as interactive video, CD-ROM, and multimedia are requiring new collaborations with people proficient in the use of these technologies as well as with others who have complementary conceptual interests that could be "accommodated" with the use of these technologies.For GT, who uses GIS in his own projects, collaborations do not come about because of the technology per se but because of the conceptual breadth of the problems that can be tackled using it. As such, he does not see new affiliations coming into existence as much as "realignments."

Whether it derives from the technology itself or from its products, collaborative research presupposes efficient communication of both concepts and methods. Almost all the participants agree that concepts are more or less universal across the social sciences (even if there is a difference in labels used) but methods differ and it is often the means of representation used that divide more than anything else.

> "We speak different languages, you know, we speak different technical languages. And one thing you have to do [in order to collaborate] is to reach a common ground where you can communicate....Everybody is mapping through their own grid, so the difficulty is in figuring out how to interdigitate grids." (BE)

GIS, according to KS, offers a way of dealing with these differences in perspective that come up when communicating across boundaries and disciplines.

> "[GIS] would give me a neutral working ground--it would give you a certain amount of respect for each other's contributions. We can see it as... I'm providing the 'human population layer' to the data set and somebody else is providing some other layer...so it's not the same, but we are going to combine it."

AC, a student of anthropology who was only recently exposed to GIS, feels the same way about it: "The program works one way, and so you can drop your layers over each other's and see how that works." The fact that GIS is built with its own set of assumptions about the way information should be handled is another matter altogether, one that users (of any technology) rarely recognize. The important aspect, as far as the user is concerned, is that it is not a set of assumptions that is necessarily "owned" by any of the collaborating parties and in that sense it is neutral.

The Public Interface

> "[Collaborative work] helps you get into the nooks and crannies of knowledge. If I had to describe it visually, when I work with a team, we end up with a linear front instead of a pointed front on our presentations!" (BK, forensic anthropologist)

The "linear front" is the broader, more holistic view of the problem that emerges with interdisciplinary (or inter-perspective) collaboration. As BE says, "It is difficult to study humans without looking at them in complex ways." These complex studies are possible only with interdisciplinary collaboration. The results of such collaboration, in order to make sense to a wider audience, must speak a language that does not belong to any one discipline alone, and use representations that have a perceived neutrality. GIS is particularly persuasive as an interdisciplinary representation tool because it can incorporate a variety of "layers" of information, each from a different source, and put them together in a way that makes new sense.

> "The main purpose of developing GIS now is as a device to not just tell people what's wrong, but actually show people what's wrong. And it's fine to say, okay, you can tell me about the mistakes and I can sort of imagine, but it's very different when you actually show them a photograph...that's the kind of intention. [GIS] has almost become a management tool in this context. It is used as an advocating tool to help [groups] make certain decisions." (GT, referring to a particular research project on watersheds)

This "show me" quality of GIS, according to its users and potential users, goes beyond simple illustrations like photographs; it renders the abstract visual. Visual technologies of all kinds are important when it comes to popularizing the results of research, or persuading key groups of the value of the results, or even simply disseminating information for educational or archival purposes. BE describes a project where she and her collaborators are using video to store all their information in a way that can be made available to the indigenous communities that it impacts or relates to. In this context, visual technologies are allowing information to reach and impact new audiences that the printed word may not reach. While GIS is a different sort of visual technology, it too has a persuasive dimension that is as important as its information dimension. So AC, the student and novice researcher, feels that GIS would not help him actually see new patterns, but "might be a way of proving the patterns to someone else...specifically for proving a point, in a graphic way." With peer audiences, this aspect is particularly important, as BK notes, that communication among scientists is "as much for consensus building as it is for knowledge production."

Discussion

Scientists use a variety of tools in the course of conducting research and arriving at conclusions. My concern here is with those tools--particularly technological ones--that have to do with information representation and manipulation. What science is in the eyes of other scientists and in the eyes of funding agencies and the public depends to no small extent on the manner in which these results are arrived at and constructed for public view. I use "public" in a very broad sense, to refer to peer audiences, funding agencies, the press and the general public.

It appears from this brief analysis that anthropologists do not explicitly acknowledge the importance of technology in the production of science; that they do recognize it is evident from their comments on how ideas grow and move. Scientific groupings seem to be more amorphous and opportunistic than many investigations of science suggest (Mulkay, 1977). What scientists talk about may be less important than who they talk to--and this is very often determined by methodological alliances rather than conceptual ones. As GT remarks, "I seek collaborations with those who approach problems from different vantage points but have some complementarity in terms of technical expertise." If the "how to" skill is so important, then it is not simply expedient but almost essential to acquire state-of-the-art skills and technological know how. BE sees technological expertise (and access) as an increasingly important factor in evaluating prospective collaborators. The graduate student AC sees GIS skills as something that will make him "definitely more marketable." In sum, who scholars talk to may in part be defined by the tools they use and the technologies they have access to.

These tools play a role in structuring the science itself, as most of the participants described. This seems to be taken for granted in the so-called "hard sciences." Most of the anthropologists, when asked this question directly, said that in a discipline like physics, the nature and direction of inquiry was very much limited by the technological infrastructure, but that it was less so in the social sciences. Certainly, the degree of influence varies, but it seems difficult to deny that there is some influence.

It is hoped that picture that emerges at the end of the study will provide more answers and draw more clearly a picture of how scientists communicate and what purpose this communication serves.

REFERENCES

Aborn, M. (1988) (Special ed.). Telescience: scientific communication in the information age. *The Annals of the American Academy of Political and Social Sciences*, 495.

Adams, D.A.,, Todd, P.A., & Nelson, R.R. (1993). A Comparative Evaluation of the Impact of Electronic and Voice Mail on Organizational Communication. *Information & Management,* 24(1): 9-21.

Ben-David, J. (1991). *Scientific Growth: Essays on the Social Organization and Ethos of Science.* Berkeley, CA: University of California Press.

Bly, S.A., Harrison, S.R., & Irwin, S. (1993). Media Spaces: Bringing People Together in a Video, Audio and Computing Environment. *Communications of the ACM*, 36 (1): 28-47.

Borden, C.M. (1992). Collaboration for better or worse? *Knowledge: Creation, Diffusion, Utilization,* 14 (1): 131-142.

Cole, J.R. & Cole, S. (1973). *Social Stratification in Science*. Chicago: University of Chicago Press.

Connors, M. (1993). *The Race to the Intelligent State: Towards the Global Information Economy of 2005.* Cambridge, MA: Blackwell.

Crane, D. (1988). *Invisible Colleges: Diffusion of Knowledge in Scientific Communities,* Revised edition. Chicago: University of Chicago Press.

Crawford, S. (1971) (Ed.). *Informal Communication Among Scientists.* Proceedings of a conference on current research. American Medical Association.

Davenport, T.H., Eccles, R.G. and Prusak, L. (1992). Information Politics. *Sloan Management Review*, 34(1): 53-65.

Dizard, W.P. (1985). *The Coming Information Age: an Overview of Technology, Economics and Politics,* 2nd. ed. New York: Macmillan.

Deetz, S. (1990). Representation of interests and the new communication technologies: issues in democracy and policy. Pages 43-62 in Medhurst, M.J., Gonzalez,, A., & Peterson, T.R. (Eds.), *Communication and the Culture of Technology*. Pullman, WA: Washington State University Press.

Esposito, E. (1993). The Computer as Medium and as Machine. *Zeitschrift fur Soziologie,* 22(5): 338-354.

Gaston, J. (1972). Communication and the Reward System of Science:a Study of a National 'Invisible College.' *The Sociology of Science*, Monograph 18:25-41.

Geertz. C. (1973). Thick description: twoard an interpretive theory of culture. In Geertz, C. (Ed.) *The Interpretation of Cultures.* New York: Basic Books.

Gerbner, G., Mowlana, H., and Nordenstreng, K. (1993) (Eds.). *The Global Media*

Debate: its Rise, Fall and Renewal. The communication and information science series. Norwood, N.J.: Ablex.

Gillespie, A. and Robins, K. (1989). Geographical inequalities: the spatial bias of the new communication technology. *Journal of Communication*, 39(3): 7-18.

Griffith, B.C. (1989). Understanding Science: Studies of Communication and Information. *Communication Research*, 16(5): 600-614.

Haywood, T. (1994). *Info-Rich, Info-Poor: Access and Exchange in the Global Information Society.* West Sussex, U.K.: Bowker-Saur.

Hunter, J. and Allen, M. (1992). Adaptation to electronic mail. *Journal of Applied Communication Research*, 20(3): 254-274.

King, E. (1994). Visual communication in science. *Scientific Computing and Automation*, 10(7): 6-8.

Knorr-Cetina, K.D. (1981). *The Manufacture of Knowledge: an Essay on the Constructivist and Contextual nature of Science*. New York: Pergamon Press.

Kuhn, T.S. (1970). *The Structure of Scientific Revolutions.* Chicago: the University of Chicago Press.

Lacroix, J.G. (1992). The New Information and Communication Technologies and Creative Work in the Cultural Industries. *Technologies de l'Information et Societe,* 4(1): 97-111.

Lan, J., Bauin, S., Courtial, S. & Whittaker, J. (1988). Policy and the Mapping of Scientific Change: a Co-word Analysis of Research into Environmental Acidification. Scientometrics, 14(3-4): 251-264.

Laudan, L. (1984). *Science and V alues.* Los Angeles: University of California Press.

Lawson, M.G. (1993). Informal Communication Patterns Among Researchers in Three Library and Information Sciencce Research Areas. Unpublished doctoral dissertation: Texas Women's University.

Lievrouw, L.A. (1989). The Invisible College Reconsidered: Bibliometrics and the Development of Scientific Communication Theory. *Communication Research,* 16(5): 615-628.

Lievrouw, L.A. (1990). Communication and the social representation of scientific knowledge. *Critical Studies in Mass Communication*, 7(1): 1-10.

Lievrouw, L.A. (1992). Communication, representation, and scientific knowledge: a conceptual framework and case study. *Knowledge and Policy*, 5(1): 6-28.

Lincoln, Y.S. & Guba, E.G. (1985) *Naturalistic Inquiry*. Newbury Park, CA: Sage.

Lodahl, J.B. & Gordon, G. (1972). The Structure of Scientific Fields and the Functioning of University Graduate Departments. *American Sociological Review,* 37: 57-72.

Longino, H.E. (1990). *Science as Social Knowledge: Values and Objectivity in Scientific*

Inquiry. Princeton, N.J.: Princeton Univesity Press.

Marvin, C. (1988). *When Old Technologies were New: thinking about electric communication in the late nineteenth century.* New York: Oxford University Press.

McKearney, C. (1995). *Uses and Impacts of Computer-Mediated Communication: a Survey of Faculty in Mass Communication and Related Disciplines.* Unpublished Doctoral Dissertation: University of Georgia, Athens.

Merton, R.K. (1942). Science and Technology in a Democratic Order. *Journal of Legal and Political Sociology,* 1: 115-126.

Mulkay, M.J. (1977). Sociology of the scientific research community. Pages 93-148 in Speigel-Rosig, I. & Price, D.d.S. (Eds.) *Science, Technology and Society: A Cross Disciplinary Perspective.* Beverly Hills: Sage.

National Academy (1993). *National Collaboratories: Applying Technology for Scientific Research.* Washington, D.C.: National Academy Press.

Nelson, C. E. and Pollock, D. K. (1970) (Eds.). *Communication Among Scientists and Engineers.* Lexington, Mass.: Heath Lexington Books.

Pan, Z. & McLeod, J.M. (1991). Multilevel Analysis in Mass Communication Research. Communication Research, 18(2): 140-173.

Pena, M. (1992). New Technologies and an Old Debate: Implications for Latin America. In

Culcliffe, S.H., Medina, M., & Sanmartin, J. (Eds.), *New Technologies, New Worlds, New Issues.* Research in Technology Studies, Vol. 6. Bethlehem: Lehigh University Press.

Pinch, T. (1990). The Role of Scientific Communities in the Development of Science. *Impact of Science on Society,* 40(3): 219-225.

Pool, I. de S. (1990). *Technologies without Boundaries.* Cambridge, MA: Harvard University Press.

Price, D.J.de S. (1963). *Little Science, Big Science*. New York: Columbia University Press.

Price, D.J. de S. (1986). *Little Science, Big Science... and Beyond.* New York: Columbia University Press.

Reynolds, P.D. (1981). *A Primer on Theory Construction.* Indianapolis: Bobbs-Merrill.

Rice, R.E. (1987). Computer-Mediated Communication and Organizational Innovation. *Journal of Communication,* 37(4): 65-87.

Rice, R.E. (1993). Media Appropriateness: Using Social Presence Theory to Compare Traditional and New Organizational Media. Human Communication Research, 19(4): 451-484.

Salmon, C.T. (1989). (Ed.). Information Campaigns: Balancing Social Values and Social Change. Newbury Park, CA: Sage Publications.

Schmitz, J. and Fulk, J. (1991). Organizational colleagues, media richness and electronic mail: a test of the social influence model of technology use. *Communication Research*, 18(4): 487-523.

Shapere, D. (1989). Evolution and Continuity in Scientific Change. *Philosophy of Science,* 56(3): 419-437.

Unruh, D.R. (1980) The Nature of Social Worlds. *Pacific Sociological Review,* 23(3): 271-296.

Van-Rossum, W. (1973). Informal Communication and the Development of Scientific Fields. *Social Science Information*, 12(6): 63-75.

Warnat, W.I. (1983). *Automation: an Illustration of Social Change.* Dearborn, MI: Society of Manufacturing Engineers.

Watkins, B.T. (1994). A far-flung collaboration by scientists.: computer project allows researchers around the world to work together. *The Chronicle of Higher Education,* XL(40): A15-17.

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