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THE DIFFUSION OF SCIENTIFIC INFORMATION IN THE COMMUNICATION DISCIPLINE:
CONCEPTUALIZATION AND PROPOSITIONS

BRENT D. RUBEN and JOHN M. WEIMANN

Scholarly work is diffused among members of a discipline through a process which is essentially communicative in nature. As such, that process serves both content and relational functions, and has unintended as well as intended consequences. Beyond the transmission of scientific and scholarly information within a field, communication dynamics shape and control the sorts of information which can be diffused and accepted. This article examines this generic role of communication in the growth and development of scholarly paradigms and literatures, with particular reference to the implications of these issues for the field of communication.

The study of the growth, development, and maturation of academic disciplines, paradigms, and writings has attracted the interest of very few communication scholars. This is somewhat surprising since the process by which scholarly work is diffused among members of a field and becomes accepted is essentially communicative in nature.

In this article we examine this process, present a conceptual framework for viewing the role of communication in the creation and diffusion of scientific information, and explore its implications for understanding the dynamics within the discipline of communication. Our approach is rooted in the tradition of theory and research commonly treated under the rubric diffusion of information, and has as its philosophical base the sociology of knowledge and symbolic interaction.¹

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COMMUNICATION AND SCIENCE

In recent years, a number of authors have become intrigued by the study of disciplinary and paradigmatic growth and differentiation. No doubt the best-known line of inquiry which has pertinence for questions of regulation, utilization, and acceptance of scientific information is the work of Kuhn,² which outlines a cyclic view of the history of science. In this perspective, new scientific paradigms are thought to be created and accepted because they provide alternative perceptual schema for viewing data which could not be well-accommodated within existing conceptual frameworks.

Diffusion

The growth and evolution of disciplines and disciplinary knowledge can be viewed as


1. We refer particularly to works such as Peter Berger and Thomas Luckmann, The Social Construction of Reality (Garden City, N.Y.: Doubleday, 1966); Peter Berger, The Sacred Canopy (Garden City, N.Y.: Doubleday, 1969); Burkart Holzner, Reality Construction in Society (Cambridge, Mass.: Schenkmam, 1966); Werner Stark, The Sociology of Knowledge (London, Routledge and

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a kind of diffusion process in which ideas are transmitted from person to person through processes of interpersonal and social influence.

Crane, summarizing the work of Coleman, explains:

When members of a social system are in communication with one another, a kind of "con-tagion" effect occurs in which individuals in a social system who have adopted an innovation influence those who have not yet adopted it. The probability that a member of such a social system will adopt an innovation increases as the number of other people with whom he communicates in the same social system increases because it is related to the number of people who have already adopted the innovation.\(^3\)

Crane further suggests:

Thus, the exponential growth of scientific knowledge can be interpreted as a "contagion" process in which early adopters influence later adopters, which in turn generates an exponential increase in the number of publications and the number of new authors entering the area.\(^4\)

**Intersubjectification and Utilization**

This perspective can be extended further to indicate a general relationship between socially generated, distributed, and intersubjectified information on the one hand, and individual integration and use of that information on the other hand.

Fundamental to such a generation-utilization paradigm are the propositions that: (1) people act toward the persons and objects in their environments based on the meanings they have for them; and (2) the meanings persons hold for physical and social objects are largely the product of social interaction.\(^5\) It is through communication that individuals relate to one another and their environments, thereby creating and perpetuating normative realities of all sorts.\(^6\)

Applied to the realm of science, such a framework leads to the position that the processes by which scientific meanings are formulated, diffused, and used are subject to the same inevitable communication dynamics as other sorts of socially created and maintained realities.

The scientist—like other persons—is understood to be intrinsically interconnected to his or her fellows through a network of complex and overlapping formal and informal information networks, which play a critical role in defining for him or her the nature of his world and the people in it. And it is through these networks that the nature of science and the scientist's role (as well as the preferred paradigms, methodological standards, and disciplinary foci and boundaries) are defined.\(^7\)

**INVISIBLE COLLEGES**

This view is supported by research which indicates the existence of invisible colleges or social circles, which are groups of scholars in a discipline who maintain informal contact with one another, and thereby influence patterns of scholarship within a discipline, especially during periods in which a field is undergoing rapid change.\(^8\)

The social circles are somewhat amorphous, yet their influence can be pervasive:

> The boundaries of this group in terms of its total membership are ... difficult to locate. Each member of a social circle is usually aware of some but not all of the others. The members of a research area are geographically separated to such an extent that face-to-face contact never occurs between all members ... It is not necessary to know a particular member of a social circle in order to be influenced by him. Not only can a scientist be influenced by publications written by another who has never met him, he can also receive information second-hand through conversation or correspondence with third parties. There is no formal leadership in a social circle although there are usually central figures.\(^9\)

According to Price, the existence of such informal networks of scholars is a direct consequence of the growth of science and the number of individuals actively involved in scientific pursuits.

Annual conferences are a primary means for collecting members of invisible colleges.\(^10\) But meeting once a year is insufficient, especially as the number of persons involved increases, so methods of day-to-day communication are devised. These include sending out reprints, preprints, and reports of work-in-progress. In addition to moving messages, members of invisible colleges are themselves moved.

Always their allegiance is to the group rather than to the institution which supports them ... For each group there exists a sort of commuting circuit of institutions, research centers, and summer schools giving them an opportunity to meetpleme ...

Such groups constitute an invisible college, in the same sense as did those first unofficial pioneers who later banded together to found the Royal Society in 1660. In exactly the same way, they give each man status in the form of approbation from his peers, they confer prestige, and above all, they effectively create a communication network by organizing a large group to a small select one of the maximum size that can be handled by interpersonal relationships.\(^11\)

But do invisible colleges only solve problems? Perhaps not. As Watzlawick, Beavin, and Jackson\(^12\) noted, all communication serves both informational and relational functions. The exchange of scientific information would hardly seem an exception. In addition to simply serving as information channels for theories and discoveries, these message paths must also be understood in terms of their relational consequences.

As information is exchanged, relationships—at least in the form of most probable paths of information flow—are gradually formed. Over time, the given individual taking into account data of certain sorts from particular persons becomes increasingly specifiable and predictable. While the initial network formation might be assumed to be dictated by perceived appropriateness of information as opposed to relational considerations, over time it becomes difficult (and perhaps impossible) to isolate variables in scientific selectivity best accounted for on the basis of the value of the people, from that more validly attributed to mutually socialized value sets, methodological preferences, and paradigms.

It is always possible, however, whether journals accepted for professional publication are so construed because of some measure of their objective quality, or whether selection is better viewed as but a consequence of mutual socialization or membership in overlapping social circles.

Both the short- and long-run impact of substantive, or informational and relational factors upon the use of information within a discipline is critical. In the social and behavioral sciences, where social constructs are the basis of both theory and application, this problem is particularly acute. The function of these networks is as apt to be dictated by their structure as by the reverse.\(^13\)

The critical point is that the generation of the data of social science and the communication of that data are independent, but rather interrelated phenomena. While one might wish to assume that information and communication networks function solely to

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4. Ibid.


8. The concept and term, "invisible college" is used extensively by Price and Crane. "Social circles" are discussed by C. Kadushin in "Power, Influence and Social Circles: A New Methodology for Studying Opinion Mak-


14. Discussions of the structural-functional cycle in communication processes provided by Richard W. Budl and Brent D. Ruben in Beyond Media: New Approaches to Mass Communication (Rochelle Park, N.J.: Hayden, 1970), and James H. Campbell and John S. Mick-

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Always their allegiance is to the group rather than to the institution which supports them. For each group there exists a sort of commuting circuit of institutions, research centers, and summer schools giving them an opportunity to meet piecemeal.

Such groups constitute an invisible college, in the same sense as did those first unofficial pioneers who later banded together to found the Royal Society in 1660. In exactly the same way, they give each man status in the form of approbation from his peers, they confer prestige, and above all, they effectively solve a communication crisis by reducing a large group to a small select one of the maximum size that can be handled by interpersonal relationships.

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As information is exchanged, relationships—at least in the form of most probable paths of information flow—are gradually formed. Over time, the probability of a given individual taking into account data of certain sorts from particular persons becomes increasingly specifiable and predictable. While the initial network formation might be assumed to be dictated by perceived appropriateness of information as opposed to relational considerations, over time it becomes difficult (and perhaps impossible) to isolate variance in scientific selectivity best accounted for on the basis of the value of the information, from that more validly attributed to mutually socialized value sets, methodological preferences, and paradigms.

It is always arguable, for example, whether papers accepted for journal publication are so construed because of some measure of their objective quality, or whether selection is better viewed as but a consequence of mutual socialization or membership in overlapping social circles.

Both the short- and long-run impact of substantive, or informational and relational factors upon the regulation and use of information within a discipline is critical. In the social and behavioral sciences, where social constructs are the basis of both theory and application, this problem is particularly disconcerting. The function of these networks is as apt to be dictated by their structure as the reverse.

The critical point is that the generation of the data of social science and the transmission of that data are not independent, but rather interrelated phenomena. While one might wish to assume that information and communication networks function solely to

transmit the products of scholarship among one's colleagues, it seems an unavoidable conclusion that a scientist cannot be isolated, independent, nor objective in any other than a superficial sense. What the scientist looks at, what he or she studies, and how the investigation proceeds is centrally influenced by the people and ideas around them. Communication, in both formal and informal networks, can therefore be conceived to be of central importance in defining, as well as transmitting and channeling scientific knowledge.

Formal and Informal Networks and Decision Making in Scientific Communication

In considering the implications of this framework, it is useful to distinguish between two types of regulatory mechanisms influencing patterns of information flow. On the one hand, there are formal information review and selection mechanisms designed to achieve quality control in journals, convention presentations, scholarly books, etc. There are also gatekeeping functions which occur as a result of informal relations among members of scientific networks (e.g., co-authorship), though less purposeful, are likely to be as influential as more formal decision-making structures. Quite clearly, both informal and formal networks have an important role in the flow of information within a discipline from discovery or development, through diffusion, publication, and subsequent use.

There have been substantial research efforts directed at systematic description of the formal networks of science, what Kuhn terms the discipline which indicate that there are a number of stages between ideation and use. Each of these stages involves formalized mechanisms for information diffusion, and each involves decision making, selectivity, and gatekeeping. It is in this connection that the importance of informal networks in the evolution of a discipline is underscored, and the social nature of the development of a discipline becomes most apparent.

Proponents of competing paradigms will often disagree about the list of problems that any candidate for a paradigm must resolve. Their standards of their definitions of science are not the same. Moreover, it is even more the incommensurability of standards. Since new paradigms are born from old ones, they ordinaril incorporate the vocabulary and apparatus that the traditional paradigm had previously employed. But they seldom employ these borrowed elements in quite the same way. Within this, informal concepts, and experiments fall into new relationships with the other. The inevitable result is that what we call, though we do not quite right, a misunderstanding between competing schools.


Kuhn, p. 149.


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The communication discipline

In this section we discuss two propositions which extend the conceptualization developed in the preceding pages, using the communication discipline as our focal point. While these propositions and the framework for the development of the theory have relevance for understanding the communication dynamics within any field, we are especially interested in their implications for our own discipline.

Proposition 1: Variables and concepts investigated by scholars are chosen largely as a function of relational or social considerations.

Social considerations are those factors which hinder or enable an individual scholar in gaining access to various groups to which he or she aspires and/or has attained or wishes to become members of—a process of exchange. If central figures in a particular social network are talking about, working on, or in other ways paying attention to a particular variable, concept, or line of research, then that variable is likely to be desirable or necessary one by one individual (from either a psychological, political, or economic point of view)—it is predictable that he or she will pay attention (i.e., the coinage of their realm will become the coinage of his or hers).

Does this mean that "pop" variables or concepts in communication or other fields are not important or scientific? No. Our point is that the scientific relevance of a variable or concept may not be the determinant of scholars' decisions as to which topics to pursue in their own research and teaching. Social rewards would seem to be primary factors explaining such decision making. One need only look to circumstances that led to the sudden interest in persuasion and propaganda following the outbreak of World War II in the work of Holst and for historical evidence. In this same vein, the availability of support from federal and private sources seems a strong influencing factor in determining the direction of research. Unsurprisingly, those who maintain that the problems for which funding is available are inherently the most appropriate phenomena for study, one is forced to conclude that certain areas of knowledge are noteworthy because of the availability of funding, may never be examined.

As noted earlier, there are rather obvious personal functions fulfilled by the social exchanges and networks of invisible colleges: (1) availability of persons with similar interests to talk with about one's work; (2) reinforcement of one's values, beliefs, and norms (themselves often learned from other members of the group); (3) comprehension of respect; (4) attribution of a sense of importance and belonging; and (5) recognition for one's work through acceptance of it in professional journals, and other publications, over which members of one's social exchange network have control or influence.


18. C. Aragon, Behind the Front Page: Organizational Self Renewal in a Metropolitan Newspaper (San Francisco: Jossey-Bass, 1974).

components, and differing views of the nature of science are endemic to particular invisible colleges—making misunderstanding between them inevitable—the impact of informal networks on the direction of formal information flow is substantial. Where gatekeepers in the formal networks—journal editors, referees, and readers—are members of the invisible college whose members' work is reflective of a particular dominant paradigm, their selection processes should have the consequence of (1) reifying the currently accepted paradigm; (2) precluding access of alternative paradigms to the formal networks which they control; and thereby (3) perhaps retarding change and evolution of the discipline.

The potential influence of interpersonal networks upon formalized information diffusion processes are perhaps best articulated by Breed,17 and more recently substantiated by Argyris.18 Who one likes talking to or having a drink with at conventions, the students, teachers, and colleagues in one's department—one's epistemic communities, invisible colleges, social circles—all make a difference in the selection of information for diffusion in formalized networks. Precisely how these factors operate, and with what consequence, ought to be a critical area of research for scholars interested in a comprehensive view of scientific communication dynamics.

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Proposition 1: Variables and concepts investigated by scholars are chosen largely as a function of relational or social considerations.

Social considerations are those factors which hinder or enable an individual scholar in gaining access to various groups to which he or she aspires and/or has attained or wishes to secure membership. This is a social exchange process.19 If central figures in a particular social network are talking about, working on, or in other ways paying attention to a particular variable, concept, or line of research—and that network is perceived as a desirable or necessary one by an individual (from either a psychological, political, or economic point of view)—it is predictable that he or she will pay attention (i.e., the coinage of their realm will become the coinage of his or hers).

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As noted earlier, there are rather obvious personal functions fulfilled by the social exchange networks of invisible colleges including: (1) availability of persons with similar interests to talk with about one's work; (2) reinforcement of one's values, beliefs, and norms (themselves often learned from other members of the group); (3) conferred of respect; (4) attribution of a sense of importance and belonging; and (5) recognition for one's work through acceptance of it in professional organizations, journals, and other publications, over which members of one's social exchange network have control or influence.


With all these potential rewards at hand, it would not be surprising that decisions are made from the vantage point of an individual's social payoff matrix—much as are many other social decisions.20 Neither is it surprising that such networks have little trouble sustaining themselves and thereby encouraging like-thinking among members concerning the nature of science, appropriate methods, and the nature of appropriate study in the discipline.

This line of conjecture leads directly to a second proposition.

Proposition 2: The quality of scholarship is determined primarily by its conformity to social criteria as manifest in paradigms and methods used in previously accepted studies.

Post hoc criteria often guide evaluations leading to: (1) conceptual and methodological conformity with extant research; (2) inclusion of pop variables; (3) citation of persons from one's social exchange network; and (4) presentation or publication of the research. It seems unlikely that new work in communication has much chance of publication when that new research area or scholar is not generally consistent with current patterns. Funds to support its study are not substantial, no currently influential social exchange network is supporting such work, or the investigator is not a central member of an extant dominant network. Generally, it seems reasonable to assume, based upon the framework developed earlier, that changes or redefinitions of pop variables are diffused through (though probably seldom initiated by) central figures (opinion leaders) in scientific communication networks. Further, it seems a logical extension of this framework to suggest that the informal "acceptance" of one's research, and its subsequent formalized acceptance, that enables publication and further diffusion is facilitated when (1) the research or scholarship is readily understandable by network members, particularly its gatekeepers; (2) the work implicitly or explicitly reaffirms the values of the network; and (3) when, through similarity to the work of the individuals within the network, a piece of research reaffirms the worth of individuals who compose such networks and their scholarship.

This dynamic would seem to encourage a progressively less generic focus among scholars within particular social exchange networks, as the pop variable or concept is applied in every imaginable situation and presented in every forum in which the work is accepted. Another important post hoc criterion often applied in deciding the worth of a research piece is its prior presentation at a convention or publication in a journal. Again, the criterion is, in each of these, perfectly sensible. But superficial acceptance of such a criterion obscures the reasonably predictable communication dynamics which underpin such phenomena. Despite growing agreement that communication is systemic, processual, and transactional, these considerations are often overlooked in our own scientific communication. Of concern is the confidence in the quality control provided through the use of "blind" refereeing or reviewing. At least three interview variables come to mind which must be considered before we accept the notion that "blind refereeing" is a prototype for objectivity in science. First, to the extent that a given study is similar to extant research, it may be evaluated vis-à-vis that research. Second, the inclusion of pop variables or concepts will, as suggested previously, give the document social exchange utility, increasing its likelihood of positive evaluation by a referee. Third, the author's membership (or lack of membership) in the pervasive epistemic community (social exchange network) will influence the likelihood that his work will be "in tune" with current values, pop variables and citations, and the like.

Often, too, the selection of referees is reflective of the informal pattern of scientific and methodological preferences—of social exchange—as are other aspects of scientific communication. Through repeated selection of a particular group of individuals, these persons risk being on the receiving end of such informal pressures. Officers of editorial boards, appointed editors or contributing editors of journals, selected to organize or plan a convention session, or referee papers for convention presentations or journals. Where the social figures of such social exchange networks gain prominence within the editorial structure of a particular journal (or journals), a scholarly association, circular validation by invisible college and social exchange networks. Further, there is a clear need for additional exploration of the sorts of issues raised in this paper, and for comprehensive research exploring the dynamics of scientific information diffusion and utilization within the communication field.

We recognize that for a number of reasons—some personal and others professional—such investigations are not undertaken lightly. Nonetheless, we believe that intellectual integrity of any field—most especially communication—demands that attention be focused on internal information-processing dynamics.

As Karl Marx noted in the first volume of Das Kapital, men often pay so much attention to the tangible products of their labor that they are blinded to the social relations and social processes out of which these products come.21 The domain of scholarship is clearly no exception, and we believe that disciplinary self-reflexiveness is nowhere more needed than in communication. In other words, it may be a luxury; for communication it is simply a necessity.

or a division therein, the mechanisms for self-affirming, self-fulfilling intellectual prophecies are in place.

Based upon this perspective, it is possible that the publication of a particular piece of work is not necessarily information about anything other than the extent to which it complies with current communication realities of editorial decision makers. The tautology which results suggests that a study is "good" because it appears in a journal or is presented at a convention, and, as we have suggested, it may appear in a journal because it conforms to the network-engendered realities of key gatekeepers which are by definition "good."

It seems clear that the framework presented in the foregoing discussion has important generic implications for the conception and study of the dynamics by which disciplines, their paradigms, and their literatures grow and evolve. Some of these have particular relevance for the communication field, given its stage of development. First, there is the obvious need to be aware of the diffusion and reification process and our own roles in it, and the impact of these on the shape and direction of scholarship in the field. It would seem particularly critical to be cognizant of the risks and consequences associated with circular validation by invisible college and social exchange networks. Further, there is a clear need for additional exploration of the sorts of issues raised in this paper, and for comprehensive research exploring the dynamics of scientific information diffusion and utilization within the communication field.

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