Rogers, E.M., & Singhal, A. (1996). Diffusion of innovations. In M.B. Salwen & D.W. Stacks (Eds.), An integrated approach to communication theory and research (pp. 409-420). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

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Diffusion of Innovations

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What is diffusion? *Diffusion* is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995). An *innovation* is an idea, practice, or object perceived as new by an individual or other unit of adoption. The diffusion process involves both mass media and interpersonal communication channels.

This chapter analyzes the research tradition of the diffusion of innovations, focusing on the origins of the diffusion paradigm, its methodological tenets, and its influence on communication research. We identify the distinctive aspects of diffusion research, detail the seminal Iowa hybrid seed corn study, explain the strengths and limitations of the dominant paradigm that guided diffusion study for several decades, and look into the future of diffusion research.

DISTINCTIVE ASPECTS OF DIFFUSION RESEARCH

Several distinctive aspects of the diffusion of innovations set it off from other specialized fields of communication study.

1. The study of the diffusion of innovations began during World War II, prior to the establishment of communication study in university schools and departments (Rogers, 1994). So diffusion research was well underway as a research activity before communication scholars entered this research front.

2. Although most observers agree that the diffusion of innovations is fundamentally a communication process, communication scholars constitute only one of the dozen research traditions presently advancing the diffusion field (along with geography, education, marketing, public health, rural sociology, agricultural economics, general economics, political science, and others). Other communication research areas such as persuasion and attitude change and mass communication effects also began prior to the institutionalization of communication study in university units (Rogers, 1994).

3. Diffusion research is also distinctive in that the communication messages of study are perceived as new by the individual receivers. This novelty necessarily means that an individual experiences a high degree of uncertainty in seeking information about, and deciding to adopt and implement, an innovation. In the sense of the newness of the message content, the diffusion of innovations is unlike any other communication study except the diffusion of news. Diffusion of news, however, studies the spread of news events, concentrating mainly on such matters as how we become aware of news. In contrast, research on the diffusion of innovations centers not only on awareness-knowledge, but also on attitude change, decision-making, and implementation of the innovation. The new ideas investigated by scholars of the diffusion of innovations are mainly technological innovations, so the behavior studied is quite different from that investigated in news diffusion studies. Obviously, however, both communication research areas involve a similar diffusion process, and both have been informed by the other (Rogers, 1995).

4. Diffusion research considers time as a variable to a much greater degree than do other fields of communication study. Time is involved in diffusion in (a) the *innovation–decision process*, the mental process through which an individual passes from first knowledge of a new idea, to adoption and confirmation of the innovation; (b) *innovativeness*, the degree to which an individual is relatively earlier in adopting new ideas than other members of a system; and (c) an innovation's *rate of adoption*, the relative speed with which an innovation is adopted by members of a system (Rogers, 1995).

5. The diffusion of innovations field emphasizes interpersonal communication networks more than any other type of communication research. From the first diffusion studies conducted about 50 years ago, the nature of diffusion was found to be essentially a social process involving interpersonal communication among similar individuals. A person evaluates a new idea and decides whether or not to adopt it on the basis of discussions with peers who have already adopted or rejected the innovation. The main function of mass media communication in the diffusion process is to create awareness-knowledge about the innovation. Study of the diffusion of innovations involves both mass communication and interpersonal communication, and thus spans the dichotomy that otherwise divides communication into two subdisciplines.

BACKGROUND OF DIFFUSION RESEARCH

The study of the diffusion of innovations in its present-day form can be traced from the theories and observations of Gabriel Tarde, a French sociologist and legal scholar. Tarde originated such key diffusion concepts as opinion leadership, the S-curve of

diffusion, and the role of socioeconomic status in interpersonal diffusion, although he did not use such concepts by these names. Such theoretical ideas were set forth by Tarde (1903) in his book, *The Laws of Imitation.*

The intellectual leads suggested by Tarde were soon followed up by anthropologists, who began investigating the role of technological innovations in bringing about cultural change. Illustrative of these anthropological studies was Clark Wissler's (1923) analysis of the diffusion of the horse among the Plains Indians. As in other anthropological works, the emphasis was on the consequences of innovation. For example, Wissler (1923) showed that adding horses to their culture led the Plains Indians, who had lived in peaceful coexistence, into a state of almost continual warfare with neighboring tribes.

The basic research paradigm for the diffusion of innovations can be traced to Bryce Ryan and Neal C. Gross's classic 1943 study of the diffusion of hybrid seed corn among Iowa farmers. This investigation was grounded in previously conducted anthropological diffusion work, which Ryan had studied while earning his doctoral degree at Harvard University, prior to becoming a faculty member in rural sociology at Iowa State University, where Gross was a graduate student. We discuss the hybrid corn study in detail later in this chapter.

During the 1950s many diffusion studies were conducted, particularly by rural sociologists at land-grant universities in the midwestern United States. They were directly influenced by the Ryan and Gross investigation. As soon as communication study began to be institutionalized, this new breed of scholars became especially interested in the diffusion of news events, particularly through an influential study by Paul J. Deutschmann and Wayne A. Danielson (1960).

COMMUNICATION RESEARCH ON DIFFUSION

Deutschmann was somewhat typical of the new breed of communication scholars coming out of the recently founded schools of communication at American research universities. He had several years of experience as a newspaper reporter and editor, and then enrolled in the new PhD program in communication at Stanford University, led by Wilbur Schramm. He gained competence in quantitative methods, communication theory, and social psychology. Deutschmann became a friend and research collaborator with Danielson, his fellow doctoral student at Stanford, and an individual with a similar background of professional newspaper experience. Deutschmann's first faculty position was in the new Department of Communication at Michigan State University, where he headed the Communication Research Center.

Deutschmann was a brilliant and intense communication scholar. Everett Rogers remembers meeting him in 1959 when he visited the newly established Department of Communication at Michigan State University. Shortly after introductions, Deutschmann showed the S-shaped diffusion curves for the spread of the news events that he and Danielson were then studying. Compared to the diffusion curves for the agricultural innovations that Rogers was investigating, the news events spread much more rapidly (Fig. 26.1). As Deutschmann stated at the time, this was "damn fast diffusion" (personal communication). Thanks to Deutschmann and Danielson's (1960) article on the diffusion of news events, this research topic became popular among communication scholars. Work on this topic continues today.

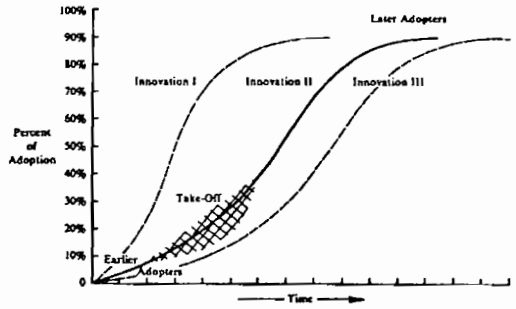

FIG. 26.1. S-shaped diffusion curves for three innovations. Compared to diffusion curves for technological innovation, news diffusion curves have a highly compressed time dimension, showing that news events spread very rapidly. Reprinted from *Diffusion of Innovations* (4th ed., p. 11) by E. M. Rogers, 1995, New York: Free Press. Copyright 1995 by E. M. Rogers. Reprinted with permission of the author.

In the early 1960s Deutschmann moved to San José, Costa Rica, where he directed a Latin American communication research center for Michigan State University. One of his first projects was conducted in collaboration with Dr. Orlando Fals Borda, a sociologist at the National University of Colombia in Bogotá. Fals Borda earned his doctorate in rural sociology at the University of Minnesota and was well-acquainted with diffusion research. For several years, he had been conducting a study in the Colombian village of Saució, a small Andean community of 71 farm households. Deutschmann and Fals Borda (1962) carried out a diffusion study in Saució, one of the first diffusion investigations in a developing nation. Soon there would be several hundred such diffusion studies, many conducted by communication scholars. The six agricultural innovations of study in Saució (such as chemical fertilizer, a new potato variety, and a pesticide) had been introduced in previous years by Fals Borda, who acted as an agricultural *change agent*—or one who introduced innovations to the public. The familiar S-shaped curve characterized the rate of adoption for each of these innovations in the Colombian village. Rather striking similarities were found between the diffusion process in this developing country village and the diffusion of agricultural innovations among commercial farmers that Rogers was then studying in Ohio (Deutschmann & Fals Borda, 1962).

Deutschmann's study with Fals Borda in Colombia stimulated interest among communication scholars in the diffusion of technological innovations. He attracted doctoral students to Michigan State University who were interested in diffusion research. When Deutschmann's life was cut short in 1962, Everett Rogers was hired as his replacement at Michigan State University to continue diffusion research in developing nations.

The number of diffusion studies completed by communication scholars expanded rapidly since 1960. By 1994, an estimated 454 diffusion publications by communication scholars were available, more than any other diffusion research tradition except rural sociology (with 825 diffusion publications) and marketing (with 569). Unlike rural sociologists, who are mainly concerned with agricultural innovations, or education diffusion scholars, who are interested in new educational innovations (for example, modern math or the multicultural curriculum), communication scholars investigate a wide range of different types of technological innovations. Communication scholars are interested in diffusion as a communication *process*, independent of the type of innovations that are diffused.

THE IOWA HYBRID SEED CORN STUDY

When Ryan arrived in Ames, Iowa, in 1938, he was intrigued with the scholarly question of noneconomic influences on economic behavior. This issue had become important to him during his doctoral studies in the Department of Sociology at Harvard University, where Robert K. Merton, a young faculty member who had recently completed his own dissertation research on the sociology of science, was Ryan's doctoral advisor. The Harvard doctoral program in sociology was relatively new, and somewhat interdisciplinary in nature. Students earning degrees in sociology were encouraged to take courses in economics, anthropology, and in social psychology. Professor Talcott Parsons, the intellectual leader of Harvard sociology, had been trained in economics in Europe and helped introduce the theories of Vilfredo Pareto to American sociology. This interdisciplinary intellectual background was good preparation for Ryan, the individual who, more than any other, was to formulate the paradigm for research on the diffusion of innovations.

Iowa State University was an agricultural college, and so Ryan decided to investigate the diffusion of hybrid seed corn. This innovation was a profoundly important new idea for Iowa farmers, leading to increased corn yields of about 20 percent per acre. Ryan received funding for his proposed study of the diffusion of hybrid seed from the Iowa Agricultural Experiment Station, Iowa State University's research and development organization, which had played an important role in developing hybrid seed. This important innovation had spread widely to Iowa farmers in previous years, but Iowa State administrators were concerned that such an obviously advantageous agricultural technology had required so many years (about a dozen) for widespread use. This type of frustration on the part of officials who cannot understand why a seemingly advantageous innovation is not adopted more immediately explains why many diffusion studies continue to be sponsored.

Ryan collaborated with several economics professors at Iowa State University in designing the hybrid corn study. As stated previously, Ryan was thoroughly familiar with the anthropological research on diffusion, and this work directly affected the design of the Iowa hybrid corn study. However Ryan proposed the seed corn study mainly as a survey relying on questionnaire-generated data, rather than using the ethnographic approaches of the previous anthropological research.

A newly arrived masters student at Iowa State, Neal C. Gross, was assigned as Ryan's research assistant. Ryan told Gross that if he would personally interview the

several hundred farmers in the two Iowa communities of study, he could use the data for his master's thesis. Gross, who came from an urban background, was unfamiliar with the ways of Iowa farmers. Someone told Gross that farmers began work early in the morning, so he appeared at the farmstead of his first respondent at 4 am. Gross averaged 14 personal interviews per day during the summer of 1939, an enviable record by today's standards for survey research.

Ryan and Gross were specialists in rural sociology in the then Department of Economics and Sociology at Iowa State University (it was later to divide into departments of economics, sociology, and anthropology). Rural sociology was an applied branch of sociology, especially valued at Iowa State, which was a land-grant, agricultural university in a predominately farming state. Further, the rural sociology specialty was organizationally situated in the College of Agriculture, a unit dominated by administrators oriented to research, education, and extension service activities devoted to increasing farm production. Obviously, an investigation of the diffusion of hybrid seed corn in Iowa fit perfectly with this value on increasing agricultural production. Ryan's proposal was approved because it was expected to provide valuable insights about why farmers had been surprisingly slow to adopt an economically profitable innovation.

The choice of hybrid seed corn as the innovation of study in the Ryan and Gross investigation was to cast a long intellectual shadow over future generations of diffusion scholarship. Hybrid seed was an overwhelmingly beneficial innovation, boosting corn yields considerably. Given the sponsorship of the hybrid corn study, it is understandable that Ryan and Gross tended to assume that Iowa farmers ought to adopt the innovation, and that the rate of adoption should have been more rapid. This pro-innovation bias still characterizes most diffusion studies today. Ryan and Gross (1943) indicated their surprise that the diffusion of hybrid corn required 12 years to reach widespread diffusion, and that the average farmer needed seven years to progress from initial awareness of the innovation to full-scale adoption (indicated by planting all of the corn acreage on his farm in hybrid seed).

Stated another way, the hybrid corn study demonstrated just how difficult it was for most individuals to adopt an innovation. Hybrid corn had to be purchased from a seed corn company, at a price per bushel not trivial to Iowa farmers in the Depression years. Further, adopting the innovation meant that Iowa farmers no longer selected the more beautiful-appearing ears of corn for use as seed the following year. So the adoption of hybrid corn meant the unadoption of a previously existing practice, the visual selection of open-pollinated seed. Hybrid corn was one of the first of the new wave of scientifically based farm innovations that were to radically change the nature of Midwestern agriculture in the ensuing decades. In 1939, Iowa farmers were not accustomed to agricultural innovations that were later to flow from the land-grant universities like Iowa State and the U.S. Department of Agriculture.

Iowa State University was the perfect place for founding the paradigm for diffusion research in yet another sense: Ames was the principal point of importation for the introduction of statistical methods in America. These techniques for quantitative data analysis began among agricultural statisticians such as Sir Ronald Fisher and Karl Pearson in England. They were created to test hypotheses about the effects of fertilizers, new crop varieties, and livestock rations. Such statistical methods as analysis of

variance and regression came to the United States in the early 1930s when Sir Ronald visited Iowa State University, where he helped establish the Statistical Laboratory. George Snedecor, leader of the Iowa State program in statistics, named the *F* statistic (for determining the significance of analyses of variance and regression) after Fisher. Snedecor popularized statistical methods for agricultural research in his book, *Statistical Methods* (1931). Iowa State's Statistical Laboratory went on to develop the area sampling methods widely used in survey research. Professors in the Department of Statistics, such as Paul G. Homemeyer, Ray J. Jessen, and Snedecor, served as informal consultants to Ryan in planning the hybrid corn study, and this pioneering diffusion investigation was designed as a highly quantitative analysis, utilizing statistical methods to test hypotheses. As noted earlier, this was a marked departure from anthropological ethnographic diffusion research.

In the late 1930s sociological research in the United States was moving toward quantification, away from the qualitative methods that had been pioneered by the Chicago School in the 1915 to 1935 era (Rogers, 1994). Sociologists thought that to become scientific was to pattern themselves after the biological and physical sciences, at least in their research methods. This move to quantification implied the use of individuals as units of response and as units of analysis, so that statistical methods, borrowed from agricultural-biological research, could be utilized in sociological studies.

Ryan and Gross's hybrid corn diffusion research expressed this sociological search for scientific respectability in its choice of methods. Data were gathered by personal interviews with all of the farmers in the two Iowa communities of Jefferson and Grand Junction (by coincidence, these communities were located within 30 miles of where Rogers grew up on a farm). Each farmer was regarded by the two rural sociologists as a decision-making unit for the adoption of hybrid corn.

The focus on individual farmers led to the greatest shortcoming of the hybrid corn investigation. Sociometric questions to measure the interpersonal network links among the Iowa farmers of study were not asked. This mistake is all the more puzzling given that diffusion is essentially a social process. While the mass media often create awareness-knowledge of an innovation, interpersonal communication with peers is necessary to persuade most individuals to adopt a new idea.

Ryan and Gross gathered data from a complete census of the farmers in Jefferson and Grand Junction, Iowa, an ideal sampling design for measuring network links and thus for determining peer influences on farmers' decisions to adopt the innovation. The farmer-respondents were asked about the sources and channels from which they first learned about hybrid corn (commercial seed dealers and salespeople were mentioned as most important) versus the sources and channels that convinced them to adopt (other farmers like neighbors and friends were reported as most important). So Ryan and Gross established the importance of social networks in diffusion, but failed to investigate them in an appropriate way.

THE DOMINANT PARADIGM FOR THE DIFFUSION OF INNOVATIONS

One can still detect the intellectual influence of the hybrid corn study on diffusion research, 53 years and some 5,000 publications later. More than any other diffusion

investigation, the Ryan and Gross study formed the paradigm for later diffusion research. What were the essential elements of this diffusion paradigm?

1. The main dependent variable was *innovativeness*, defined as the degree to which an individual or other unit is relatively earlier to adopt than are others. For convenience in understanding diffusion research results, the continuous variable of innovativeness is often divided into adopter categories, such as innovators, early adopters, early majority, late majority, and laggards (Rogers, 1983). Ryan and Gross (1943) were the first to use adopter categories in their analysis (although they did not use these five categories by name).
2. When the cumulative number of farmers adopting hybrid corn was plotted over time, the distribution formed an S-shaped curve. When plotted on a frequency basis, the number of adopters over time formed a normal, bell-shaped curve (which later scholars utilized to divide the variable of innovativeness into the five adopter categories in a standard way).
3. The Iowa farmers' sources and channels of communication were found to differ at various stages in the innovation–decision process with the mass media more important at the awareness-knowledge stage and with interpersonal communication, especially from peers, more important at the persuasion stage. The notion of stages in the individual's innovation–decision process has been widely utilized by later diffusion scholars (Rogers, 1983).

The importance of the hybrid corn study in forming the paradigm for work on the diffusion of innovations is illustrated by Diane Crane's (1972) analysis of the invisible college of rural sociology diffusion researchers: 18 of the 30 most important scholarly innovations in the field were reported in the Ryan and Gross (1943) study. Each intellectual innovation consisted of the first time that either a dependent or an independent variable was used in an empirical study of diffusion. So the methods of study as well as what to look for in diffusion investigations were established by Ryan and Gross.

Because of World War II, the diffusion paradigm created by Ryan and Gross did not spread immediately among rural sociologists. A decade-long delay, until the mid-1950s, resulted from Gross' serving in the Navy while Ryan worked for a United Nations agency (he did not return to the faculty at Iowa State University after World War II). Two other Iowa State rural sociologists, George M. Beal and Joe M. Bohlen, popularized the diffusion paradigm, starting in 1954, and soon this approach to studying the diffusion of agricultural innovations was taken up by a widening circle of rural sociologists, especially at land-grant universities in the Midwestern states. By 1960, some 405 diffusion publications had appeared, with the largest number authored by rural sociologists. However, this diffusion research tradition soon ran out of intellectual gas, and thereafter fewer and fewer diffusion studies were conducted by rural sociologists.

SPREAD OF THE DIFFUSION PARADIGM

Meanwhile, the diffusion approach infected the other social sciences, and spread to other fields such as marketing, industrial engineering, and education. The key event in

this wider acceptance was James S. Coleman, Elihu Katz, and Herbert Menzel's 1966 study of the diffusion of tetracycline, a new medical drug, among physicians. This investigation began when the director of marketing at the Pfizer drug company approached the three sociologists, then at Columbia University's Bureau of Applied Social Research, with a request to determine the effectiveness of Pfizer's tetracycline advertising in medical journals. This rather humdrum marketing question was converted into a particularly influential diffusion study by Coleman, Katz, and Mendel (1966).

They collected data via personal interviews with virtually all of the medical doctors in four small communities in Illinois. Prescription data were also collected from pharmacies, so they knew the date when each doctor first prescribed the new drug. This represented an important methodological improvement—observed actual adoption—over the usual diffusion investigation, which depended upon respondent accuracy in recalling the date at which an innovation was adopted. Further, Coleman et al. asked sociometric questions to determine the interpersonal network links among their sample. Interestingly, they were not aware of Ryan and Gross's hybrid seed corn study until after they had completed their data-gathering.

The rate of adoption of tetracycline followed an S-shaped curve, as had the rate of adoption for hybrid corn, although only 17 months elapsed before most doctors had adopted (compared to 12 years for the Iowa farmers adopting hybrid seed). The most innovative medical doctors were cosmopolite, making numerous out-of-town trips to medical specialty meetings. Similarly, the farmer-innovators in the hybrid corn study made numerous trips to Des Moines, the largest city in Iowa, located about 90 miles away. As with the Iowa farmers, mass media channels (such as articles in medical journals) were most important in creating awareness-knowledge, while interpersonal communication channels with peers were most important in persuading a doctor to try the medical innovation.

By far the most unique intellectual contribution of the medical drug study was the evidence that it provided of diffusion as a social process. For instance, Coleman et al. (1966) found that doctors who were linked in more interpersonal networks adopted the innovation more rapidly than did more isolated doctors. Even though tetracycline had been scientificly evaluated in numerous clinical trials, which were reported to the medical doctors of study in medical journals, and even though Pfizer salespeople gave them free samples, they evaluated the innovation mainly through the personal experiences of their fellow doctors. An early adopting doctor might tell his office partner, a social friend, or a golfing partner, "Look doctor, I prescribed tetracycline to several patients of mine last week and it acted like a miracle drug. Perhaps you should try it." Thus, the meaning of the medical innovation was socially constructed through interpersonal communication among peers. Since the Coleman et al. (1966) medical drug study, many other diffusion researches (i.e., Rogers & Kincaid, 1981; Anwal & Singhal, 1992) have gathered network data to better understand the social influences on individual's innovation-decisions.

The Bureau of Applied Social Research at Columbia University was a particularly prestigious center for social science research at the time of the drug study, and Coleman and Katz were soon to become much-admired scholars. The diffusion paradigm spread rapidly and was utilized by other sociologists. Publication of a general textbook about

diffusion (Rogers, 1962) helped widen paradigm application in such fields as geography, economics, psychology, political science, and, as related previously, communication. In 1994, around 5,000 publications on the diffusion of innovations appeared (Rogers, 1995). The most important fields studying diffusion, as expressed in the number of diffusion publications published (in descending order) were rural sociology, marketing (and management), and communication.

RESEARCH METHODS FOR STUDYING DIFFUSION

Most diffusion researchers have followed the methodological path set forth by Ryan and Gross in the hybrid corn study. Data are mainly gathered by personal or telephone interviews from respondents who are asked to retrospect about their time of adoption, the sources or channels of communication that they used in the innovation-decision process, to report their network links with others, and other variables such as their personal and social characteristics. The individual is usually the unit of analysis, although in recent years a number of studies have been conducted in which an organization is the unit of analysis (Wildemuth, 1992; Zaltman, Duncan, & Holbek, 1973). Inadequate scholarly attention has been given to the consequences of technological innovations (only anthropologists have investigated such consequences in any significant way).

Alternative methods of data gathering have been little utilized, even as a means to supplement the predominant approach of survey data gathering and quantitative methodologies of data analysis. One wonders why ethnographic methods like in-depth interviews and observation have not been utilized more widely, especially in the organizational innovation studies—many of which are conducted by organizational communication scholars and by students of organizational behavior, both of whom increasingly utilize ethnographic methods. The dominant style of diffusion investigations is thus the quantitative analysis of data gathered by survey interview methods from large samples. The overall effect of these dominant research methods has been to emphasize an understanding of the diffusion process as the product of individual decisions and actions. Interpersonal influences on individuals in the diffusion process have been underemphasized because of the research methods used. Perhaps the approach to studying diffusion formulated by Ryan and Gross has become overly stereotyped.

However, in recent years, several communication scholars have investigated the critical mass and individual thresholds in the diffusion process, especially for the spread and adoption of interactive innovations such as electronic mail or fax in an organization or in some other system (Markus, 1987; Kramer, 1993). At a certain point in the diffusion process for any innovation, the rate of adoption begins to suddenly increase at an inordinate rate. This take-off in the rate of adoption creates the S-curve of diffusion (see Fig. 26.1).

For innovations that are essentially a means of interactive communication, however, such as the new communication technologies of fax and e-mail, a critical mass occurs when the diffusion process becomes self-sustaining. After the critical mass point, individuals in a system perceive that "everybody else" has adopted the interactive

innovation. With each successive adopter of an interactive innovation, the new idea becomes more valuable not only for each future adopter, but also for each previous adopter.

For example, consider the first adopter of the telephone in the United States about 120 years ago. This innovation had zero utility to the first adopter. But when a second adoption occurred, the innovation became more valuable to both parties. And so it went until gradually there were so many adopters that an individual could assume that anyone he or she might wish to call would also have a telephone. Note that the first adopters of the telephone had a very low threshold of resistance to the innovation (they adopted when there was little actual benefit for doing so). Valente (1995) reanalyzed the Coleman et al. data in light of such concepts as the critical mass and individual thresholds, which he helped formulate and sharpen theoretically. Perhaps Allen (1983) said it all when he described the diffusion process for an interactive innovation as one in which "everyone is watching while being watched" (p. 270).

THE FUTURE OF DIFFUSION RESEARCH

Perhaps one might wonder why diffusion research has persevered for so many years, and why the number of diffusion publications continues to grow. Few other areas of communication research have such a lengthy history and represent such a tremendous scholarly outpouring. We suggest that the popularity of diffusion research is due to its practical importance and its applied nature. The agricultural officials at Iowa State University in the late 1930s who sponsored the hybrid corn study have contemporary counterparts in other organizations who are equally frustrated as to why their innovations are not adopted more rapidly; thus, diffusion studies continue to flourish.

Also, diffusion research promises to enhance our understanding of how social change occurs, a fundamental issue for all scholars of society. What is the role of technology in bringing about social change? One way to find out is through diffusion research, a microlevel type of study of the macrolevel issue of social change. Scholarly interest in new communication technologies by communication students has given a special boost to interest in diffusion research in recent years. There is no reason to expect that the scholarly popularity of diffusion research by communication (and other) scholars will decrease in the foreseeable future. Innovations continue to be generated and studied.

ANNOTATED BIBLIOGRAPHY

J. S. Coleman, E. Katz, & H. Menzel (1966). *Medical innovation: Diffusion of a medical drug among doctors.* Indianapolis, Bobbs-Merrill. One of the most influential diffusion studies in showing that the diffusion of an innovation is essentially a social process that occurs through interpersonal networks.

E. M. Rogers (1995). *Diffusion of innovations.* New York: Free Press. A comprehensive textbook that reviews the main investigations of diffusion and provides a general framework (which is an updated version of the Ryan and Gross paradigm).

B. Ryan & N. C. Gross (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology, 8,* 15–24. The most important diffusion study of all time, which set forth the paradigm for diffusion research.

REFERENCES

Allen, D. (1983). New telecommunication services: Network externalities and critical mass. *Telecommunications Policy, 12,* 257–271.

Anwal, M. A., & Singhal, A. (1992). The diffusion of the Grameen Bank in Bangladesh. *Knowledge, 14,* 7–28.

Coleman, J. S., Katz, E. & Menzel, H. (1966). *Medical innovation: Diffusion of a medical drug among doctors.* Indianapolis, Bobbs-Merrill.

Crane, D. (1972). *Invisible colleges.* Chicago: University of Chicago Press.

Deutschmann, P. J., & Danielson, W. A. (1960). Diffusion of knowledge of the major news story. *Journalism Quarterly, 37,* 345–355.

Deutschmann, P. J., & Fals Borda, O. (1962). *Communication and adoption patterns in an Andean village.* San José, Costa Rica: Programa Interamericano de Informacíon Popular.

Kramer, R. (1993). The policies of information: A study of the French Minitel System. In J. R. Schement & B. D. Ruben (Eds.), *Between communication and information* (pp. 453–586). New Brunswick, NJ: Transaction.

Markus, M. L. (1987). Toward a "critical mass" theory of intensive media: Universal access, interdependence, and diffusion. *Communication Research, 14,* 491–511.

Rogers, E. M. (1962). *Diffusion of innovations* (1st ed.). New York: Free Press.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed.). New York: Free Press.

Rogers, E. M. (1994). *A history of communication study: A biographical approach.* New York: Free Press.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Rogers, E. M., & Kincaid, D. L. (1981). *Communication networks: A new paradigm for research.* New York: Free Press.

Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology, 8,* 15–24.

Snedecor, G. (1931). *Statistical methods.* Ames: Iowa State University Press.

Tarde, G. (1903). *The laws of imitation,* (E.C. Parsons, Trans.). New York: Holt.

Valente, T. W. (1995). *Network models of the diffusion of innovations.* Creskill, NJ: Hampton Press.

Wissler, C. (1923). *Man and culture.* New York: Thomas Y. Crowell.

Wildemuth, B. M. (1992). An empirically grounded model of the adoption of intellectual technologies. *Journal of the American Society for Information Sciences, 43,* 210–224.

Zaltman, G., Duncan, R., & Holbek, J. (1973). *Innovations and organizations.* New York: Wiley.