Re-Thinking the Role of Information in Diffusion Theory: An Historical Analysis with an Empirical Test

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Abstract

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The major premise of this paper is that the commonly-accepted generalization -- that mass media are most effective in bringing about awareness, and interpersonal media are best at persuasion -- was shaped and to some extent distorted by a preoccupation with the rediscovery of the group, along with a research emphasis on finding the most influential communication channels rather than exploring how the overall patterns of information source use might affect the process.

Re-thinking the Role of Information in Diffusion Theory: An Historical Analysis with an Empirical Test

The 1930-1960 period, during which much of communication theory began to develop, was a time of "rediscovery" of the group – the idea that the group serves as the interface between the individual and society. In the case of diffusion theory, this rediscovery engendered a "dominant paradigm" focusing on group processes, interpersonal communication, and influence – informed by a spurt in empirical research and several new conceptual leaps – that shaped and was itself influenced by researchers whose funding base and interests were practical and applied. Diffusion generalizations spawned in the 1950s have guided not only 4,000 subsequent empirical studies, but have also had a profound effect on the activities of communication strategists.

One of the key generalizations that emerged is that different channels of communication play key roles at different points in the adoption process. Mass media play their key role in bringing about initial awareness and knowledge of new ideas and practices, while interpersonal sources are relied upon when deciding whether or not to adopt. The idea of these discrete functions for communication channels has found its way into the mainstream literature on how to use communication effectively to bring about social change. In a review, Chaffee (1979) noted that this discrete function idea constitutes one of the most enduring generalizations derived from research on human communication.

In hindsight, however, while it is clear how researchers were led to the conclusions they drew at the time, examination of the origins of the generalizations suggests that this generalization, and especially its practical interpretation, does not now, and to some extent never did match the actual diffusion process. The major premise of this paper is that the generalizations concerning the role of information in the diffusion process were shaped and to some extent distorted by a preoccupation with the rediscovery of the group, and a research emphasis on finding the most influential communication channels rather than exploring how the overall patterns of information source use might affect the process. This was combined with a methodological approach that was inadequate to measure the synergistic contributions of multiple information sources to the diffusion process. This paper has three main purposes:

1. Explore the basis of the original generalizations in the context of the time in which they developed, and demonstrate how conceptual preoccupations and methodologies led to conclusions that failed to adequately explain the role of communication;
2. Offer four propositions that could form the basis for revised generalizations concerning the role of information in the diffusion process;
3. Provide a preliminary empirical test of the propositions, using a longitudinal dataset of the adoption of computers over a 15-year period.

Diffusion Theory

Diffusion theory is one of the most commonly-used theories in the social sciences, education, health and marketing, and is standard fare in most communication theory or communication strategy and planning courses. While interest in this theoretical area peaked in the late 1950s and 1960s and then declined, it has had a resurgence of sorts due to the current great interest in new communication technologies and how they might affect society.

"Diffusion" is concerned with the spread of ideas from originating sources to ultimate users. Research concerns have focused on the speed at which an innovation spreads and the factors that facilitate or inhibit this spread. Perhaps the most significant finding is that a significant time lag exists between the introduction of an innovation into a social system and its acceptance by most members of that social system. The time required varies from system to system and among innovations in the same system, but usually a period of years or decades is required for fairly complete diffusion. An S-shaped diffusion curve has been found for the majority of innovations studied.

What has been termed the "classic" diffusion model was developed by a small group of rural sociologists in the early 1950s who became part of a North Central states subcommittee that synthesized and published the results. In 1954, the original draft was integrated by George M. Beal and Joe M. Bohlen of Iowa

State University as a flannel board presentation entitled "The Diffusion Process" (North Central Regional Publication No. 1, 1962).

The classic diffusion model included five stages of the adoption process – awareness, interest, evaluation, trial and adoption – and suggested that there were discrete functions for different information channels at different stages. Everett Rogers later re-named the stages, and added a "confirmation" stage following adoption in 1971 (Rogers with Shoemaker, 1971) and a "re-invention" stage between adoption and confirmation in his 1983 and 1995 books (Rogers, 1983, 1995).

The classic 1954 diffusion model also included the idea that individual differences cause people to adopt innovations at different time periods and utilize varying amounts and sources of information. Five categories of adopters were conceptualized: innovators (first 2.5%), early adopters (next 13.5%), early majority (next 34%), late majority (next 34%) and late adopters or laggards (last 16%).

The 1954 Bohlen and Beal flannel board presentation also noted that there were different types of innovations, and that their characteristics affect the adoption process. It distinguished between changes in materials and equipment, changes in improved practices, and an "innovation" requiring new use patterns. Later, these characteristics were re-worked to include Linton's (1936) approach including "compatibility" of the innovation (see Lionberger, 1952, p. 140). By the time North Central Regional Extension Publication No. 13 was issued in October,

1961, factors included compatibility, divisibility, complexity, and visibility (North Central Regional Extension Publication No. 13, 1961). By 1962, "relative advantage" had been added to the list (Subcommittee for the Study of Diffusion of Farm Practices, 1962).

Origins of Generalizations about the Role of Information in Diffusion

The generalizations concerning the role of information in the diffusion process arose from a focus by rural sociologists on a practical problem: how to encourage farmers to adopt new agricultural technologies such as antibiotics, fertilizers, herbicides and other improved practices. Beginning in the early 1940s, Bryce Ryan and Neal Gross (1943, 1950) had conducted what would become the seminal study of how Iowa farmers adopted hybrid seed corn. Setting the stage for what would come later, they took a structural functionalist approach that borrowed from earlier sociological diffusion research (Chapin, 1928; Bowers, 1938), but moved analysis from an aggregated to an individual level. They believed that social factors, and not just the economists' "invisible hand" played a key role in social change. As society modernized, they reasoned that different individuals would be affected at different points in time, and that this would be reflected in differential adoption rates of new practices. In their study, they set forth: (1) the "S" shape of the rate of adoption of an innovation over time; (2) the characteristics of the various adoption categories; and (3) the relative importance of different communication channels at various stages in the innovation decision

process. Ryan designed the study to examine "social factors in economic decisions" (Rogers, 1995). Results showed that farmers tended to name salesmen (who were often other farmers) as their first source of information about hybrid seed corn, and friends or neighbors as the channel used when they made their decision to adopt. Ryan and Gross concluded that interpersonal channels were very important in the diffusion process.

Herbert Lionberger (1952, 1960) also took a functionalist approach, building on Linton's (1936) idea that cultural differences between regions affect adoption. His research (1951: 28) focused attention on the use of both mass media and personal sources of information by both low resource and high resource farmers. By 1951, Lionberger had concluded that "personal sources" (friends, agricultural agents) are more convincing than "impersonal" ones (reading, radio). He reached this conclusion because the use of personal sources (experts and neighbors) correlated more highly with use of an index of technological practices than did impersonal sources (newspapers, magazines, radio).

Eugene Wilkening took a psychological approach, suggesting that different individual perceptions of an innovation lead to different uses of information sources. His research (1953) began to link the use of information sources to stages of the adoption process. In a study of Wisconsin dairy farmers, Wilkening explored Ryan and Gross's idea that the sources of information farmers used for "initial" knowledge might be different than "those they use for

understanding how it can be made more effective after it is adopted" (Wilkening, 1956: 361). He divided information-seeking into three categories: (1) awareness: hearing about the change; (2) decision-making: information that helps decide whether or not to try it out; (3) action: instructions on how to put the change into effect. Although Ryan and Gross had found that salesmen were the first source of information about hybrid seed corn, Wilkening hypothesized that mass media, including magazines, newspapers and radio programs, would be the most frequently mentioned first source. Building on the work of Lionberger and his own studies in North Carolina, he noted that both low-income and high-income farmers tended to use mass media sources. Therefore, he predicted that these sources would be used to create awareness. It should be noted that an important difference between Wilkening's approach and Ryan and Gross was that Wilkening did not ask about any particular innovation. Instead, he asked where farmers got information about "new ideas in farming." This tends to produce important differences in responses. For example, contemporary studies asking general audiences where they get their "news" tends to lead to a response of television, while asking about some particular news event yields responses such as newspapers, magazines, friends, etc. Wilkening's results were in accord with his expectations. Mass media were often named as an initial source (63% of cases), while "other farmers" were mentioned as the source that helped them decide (47% of cases, compared to only 4% for mass media).

A. Lee Coleman and C. Paul Marsh (1955) were concerned with communication aspects of the diffusion process. They were interested in understanding differences between communities (high adoption, low adoption), groups, and individuals so they could tailor communication messages for maximum effectiveness.

In 1951, a subcommittee representing rural sociologists from North Central states working on farm diffusion was created with Eugene Wilkening from the University of Wisconsin as co-chair along with Neal Gross from Iowa State University. Other members were Lee Coleman, Kentucky; Charles Hoffer, Michigan State; and Harold Pedersen, South Dakota. Herbert Lionberger was added by 1952 (Lionberger, 1952: 141). By 1954, the subcommittee added Joe Bohlen, Iowa State, as chair, replacing Gross, Paul Miller, Michigan State replacing Hoffer, and Robert Dimit, South Dakota State. Harold Pedersen also left the committee (Subcommittee for the Study of Diffusion of Farm Practices, 1955). Bohlen and an Iowa State colleague, George Beal, played a key role in the development of the generalizations linking information seeking to stages of the adoption process.

Bohlen and Beal accepted the structural functionalist approach of Ryan and Gross. One of their major contributions was to add a conceptual basis for the stages of the adoption process. The work of Mead (1950) and Dewey (1910) was used to suggest that there are general stages of inquiry people go through when solving problems. Bohlen and Beal adapted these stages specifically for

innovations. They also were concerned with peer influence, small group dynamics, and social psychology. Their research on community action and community leadership also influenced them to focus on how interpersonal influence brings about change.

It is important to note that although they were presented as "generalizations," and built on the previous work by Lionberger, Wilkening and Ryan and Gross, Bohlen and Beal's stage-based generalizations had not yet been subjected to empirical test across the five stages of the adoption process developed by the subcommittee. Bohlen and Beal first presented the generalizations as part of a flannel board presentation to Iowa State University Extension in 1954. In 1955, they presented them to the National Project on Agricultural Communications at Michigan State University. In 1958, a major presentation to leading corporate marketing executives took place. Over the next few years, they would repeat their presentation to more than 800 audiences of groups often numbering 400 or more (Chang, 1998:23; Rogers, 1975: 11).

The generalizations were first published in 1955 as North Central Regional Publication No. 1 (Subcommittee for the Study of Diffusion of Farm Practices, 1955). The report credited members of the subcommittee as accepting full responsibility for the report. In its first four years, more than 80,000 copies of the report were sold (North Central Regional Extension Publication No. 13, 1961), a phenomenal success for a research publication. A shortened version produced by Iowa State University Extension distributed even more copies. The

Subcommittee also published a bibliography of 110 relevant research publications (North Central Rural Sociology Committee, 1959). Rogers (1975) noted that the members of this subcommittee constituted an "invisible college" that played an important role in shaping both the theoretical paradigm and methodological approaches used in diffusion studies.

For several reasons, relatively few of the thousands of diffusion studies dealt with generalizations about information-seeking. Most diffusion studies did not focus on information seeking at all. Instead, they were concerned with patterns of adoption, socio-economic characteristics (age, education, social status, farm size) and innovation-specific factors. Rogers with Shoemaker (1971) provide an appendix classifying diffusion studies by the generalizations they tested.

Generalizations concerning the role of information in the diffusion process developed by the rural sociologists were of two basic types. First were generalizations having to do with the overall use of information sources. In 1961, Bohlen and the other members of the subcommittee argued that "the typical innovator not only receives more different types of information about new practices, but also is likely to receive information sooner and from more technically accurate sources" (North Central Regional Extension Publication No. 13, 1961: 8). Rogers (1962) formalized the generalization: "Earlier adopters utilize a greater number of different information sources than do later adopters" (p. 313). This generalization had been supported by a number of earlier studies.

The second type of generalizations were new, and grew out of the flannel board presentation of Bohlen and Beal. They take a discrete function approach to information source use. Two key generalizations – one dealing with the role of mass media at different stages of the adoption process, and the other with interpersonal communication with friends and neighbors – emerged from the first published work of the Subcommittee. The generalizations suggested that information channels have discrete functions. According to the Subcommittee for the study of Diffusion of Farm Practices (1955):

> "It is at the awareness stage that the mass media devices have their greatest impact. The evidence is that for the majority, mass media become less important as sources of information after the individual has become aware of the ideas (p. 4)." Later, it observes: (p. 5): "the data available indicate that as people are evaluating an idea for their own use, they usually consult with neighbors and friends whose opinions they respect …. The reasons for the apparent lack of importance of mass media and salesmen at this and later stages of the adoption process are: (a) the information they provided through these channels is too general; (b) the potential adopters mistrust some mass media information because they feel that the information is tempered by the business interests of those who are in control of them."

The Elaboration and Testing of the Generalizations

The importance and relative newness of the discrete function generalizations can be seen by examining the overall pattern of diffusion studies up until that time. Table 1 divides key diffusion studies along two dimensions. On the left-hand side are studies that examine the first type of generalization -- general information-seeking both for general topics (Quadrant 1) and for specific innovations (Quadrant 2). Such studies considered both mass media and interpersonal channels to be important, but did not consider the possibility that the use of channels might change as an individual moved from one adoption stage to another. Studies on the right-hand side of the figure focus on the discrete function, explicitly considering information seeking by stage of the adoption process. Those in Quadrant 3 are for innovations in general, while those in Quadrant 4 are for specific innovations. The studies are arranged in each quadrant by date. Note that when the two generalizations were put forward in 1954, only Ryan and Gross's original 1943 corn hybrid seed study was found in Quadrant 4, and the only other study examining information-seeking by stages was Wilkening's 1953 study in Quadrant 3.

Table 1: Subcommittee Rural Diffusion Studies Sorted by General versus Specific Innovations And Information-Seeking in General or by Stages

Quadrant 1 **Diffusion studies of <u>general</u> information-seeking for <u>general</u> innovations**	**Quadrant 3** **Diffusion studies examining information-seeking by adoption <u>stages</u> For <u>general</u> innovations**
USDA Vermont Study (1947) Lionberger (1951) Coleman and Marsh (1955) Lionberger (1955; 1957); Lionberger and Coughenour, 1957) Dickerson (1955) Fliegel (1956) van den Ban (1957) Lionberger and Campbell (1971) Yancey (1982)	Wilkening (1953; 1956), 636 Wisconsin farmers Lionberger and Chang (1981) 396 Taiwan Farmers
Quadrant 2 **Diffusion studies examining <u>general</u> Information seeking for <u>specific</u> innovations**	**Quadrant 4** **Diffusion studies examining information-seeking by adoption <u>stages</u> For <u>specific</u> innovations**
Wilson and Trotter (1933) Bowers (1938) Wilkening (1950; 1952) Abell (1951) Marsh and Coleman (1954) Dimit (1954) Lionberger (1955) Campbell (1959) Rogers and Burdge (1962) Lee (1967)	Ryan and Gross (1943, 1950) Beal and Rogers (1957); Rogers and Beal (1958) Coleman, Katz, and Menzel (1957; 1959; 1966) Copp, Sill and Brown (1958); Sill (1958) Beal and Rogers (1960) Rogers and Pitzer (1960) Rogers and Burdge (1961) Rahim (1961) Deutschmann and Fals-Borda (1962) Mason (1962, 1963) Rogers and Leuthold (1962) Lionberger (1963) Rogers (1964); Rogers and Meynen (1965) Mason (1964) Singh and Jha (1965); Jha and Singh (1966) Jain (1965) Sawhney (1967) Rogers with Svenning (1969)

In the first two studies designed to test the generalizations, Rogers and Beal (1958) argued logically that they should be supported:

> "Most new farming practices are developed through research. The impersonal mass media devices of newspapers, farm papers and magazines, radio, television, and commercial publications all attempt to rapidly communicate these research findings to the farmers. Thus it would seem reasonable that the majority of farmers, especially the early adopters, would become aware of new farming practices through the impersonal mass media sources.
>
> However, an understanding of the social relations of most farmers and the mental processes involved at the information and application stages would suggest that personal sources may play the more important role at the information and application stages." (Rogers and Beal, 1958: 330)

Researchers at Columbia University

The 1954-1957 time period was one of significant conceptual creativity, research and dissemination for the rural sociologists. However, that same time period was also of great importance for another group of researchers who shared the rural sociologists' concerns about the practical effects of mass media and interpersonal communication channels. Because this other group was using the same general paradigm emphasizing the importance of influence and groups in the communication process, it is important to examine the origins of their work, as well as how the two groups eventually merged. Paul Lazarsfeld, Bernard

Berelson, and Hazel Gaudet published *The People's Choice* in 1948, a book concerning the role of mass media and interpersonal channels in the 1940 presidential election. The book was widely heralded as indicating the importance of interpersonal communication channels and "opinion leaders" in influencing voters. By 1955, when Bohlen's subcommittee was first publishing its generalizations, Elihu Katz and Paul Lazarsfeld were publishing *Personal Influence*, which contained an extensive review of research on the use of mass communication and interpersonal channels to influence audiences. The book emphasized the "re-discovery" of the importance of social groups in communication and persuasion, and represented a declaration of victory over mass communication theorists who had viewed audiences as "atomistic" individuals who could be directly persuaded by mass media. The book launched the "two-step flow" theory of communication which postulated that mass media influence traveled through opinion leaders who interpreted their content to audiences that used the information to decide how to vote. In a conclusion very similar to that of the rural sociologists, they found that interpersonal sources are the key to persuading individuals to change. That is, information channels have discrete functions in changing human behavior. Katz and Lazarsfeld based their work on a number of small group research studies including the industrial (Hawthorne studies from 1924 through the 1930s emphasizing social relations as a key factor in industrial output – (Roethlisberger and Dickson, 1941)), military (The American Soldier studies showing the willingness of U.S. troops to fight in

World War II was dependent upon informal group processes – (Stouffer, 1949; Shil, 1950)), and urban (The Yankee City studies showing the key role social cliques play in placing groups socially – (Warner and Lunt, 1941)) studies that re-emphasized the importance of groups in the persuasion and communication process.

Katz and Lazarsfeld (1955:3) concluded:

> "The 'rediscovery' of the primary group is an accepted term now, referring to the belated recognition that researchers in many fields have given to the importance of informal, interpersonal relations within situations formerly conceptualized as strictly formal and atomistic. It is 'rediscovery' in the sense that the primary group was dealt with so explicitly (though descriptively and apart from any institutional context) in the work of pioneering American sociologists and social psychologists and then was systematically overlooked by empirical social research until its several dramatic 'rediscoveries'" (Katz and Lazarsfeld, 1955: 3).

Remarkably, in 1955, despite the fact that their research concerned very similar theory and research interests, neither of these two groups had noted or cited each other. (An article by Coleman and Marsh, 1955, had cited Lazarsfeld and Berelson, but only as an example of communication research. The similarities to the work of rural sociologists were not noted). Thus, the initial generalizations made by both groups were developed independently. Although

the two groups discovered each other a year later, the generalizations that had developed in each area were not changed immediately in any substantial way. Rather, the discovery of each other led mainly to the citing of each other's work as an indicator of the importance of their overall topical area.

Common themes in both areas included:

1. A focus on influence – how media and interpersonal sources lead to changes in adoption and voting behavior;
2. A concern with both mass media and interpersonal channels, with a primary role for influence placed with interpersonal channels and social groups;
3. A focus in the original research on practical recommendations that could be derived from the research, rather than on building rigorous theory;
4. An approach examining communication behavior and decision-making over extended time periods.

The emphasis of the Columbia group on practical outcomes and interpersonal communication is evident in the introduction Katz and Lazarsfeld wrote in their 1955 book:

> "Our purpose, of course, is to try to point the way for the planning of research on the transmission of mass persuasion via the mass media – and particularly, for the incorporation of a concern with interpersonal relations into the design of such research. By attempting to specify exactly which elements of person-to-person interaction might be relevant for mass media effectiveness, and by exploring what social science knows about the workings

> of these elements, we shall contribute, perhaps, to a more complex – yet more realistic – formulation of a "model" for the study of mass persuasion campaigns" (p. 44).

Everett Rogers, who in 1954 became a graduate student of George Beal at Iowa State, wrote in 1975 (Rogers, 1975) that he "stumbled across" an educational diffusion study by Paul Mort, Columbia University, while leafing through a journal in the waiting room of a professor's office. He also found a medical diffusion study conducted by Coleman, Katz and Menzel. In 1956, he got a small grant to attend a conference in New York that was also attended by Columbia researchers James Coleman, Elihu Katz and Herbert Menzel. As a result of the meeting, Rogers said he "became convinced that a general diffusion process occurred for many types of innovations" (p. 12).

While Rogers' attendance at the New York conference solidified his own thinking, researchers from both groups had already begun to notice one another. Menzel and Katz (1955-56) cited Wilkening, Lionberger and Marsh and Coleman – all key farm diffusion studies – as being relevant. In 1956 Wilkening (1956) also cited a number of Columbia studies in the same way.

The mutual discovery led to new material in the literature of both areas, and a 1960 article by Katz weaving together the strands of research from rural sociology, small group research, education, medical sociology, industry and other areas. Although the Beal and Rogers diffusion article in 1957 (Beal and Rogers, 1957) makes no mention of Katz or the Columbia researchers, by 1958

(Rogers and Beal, 1958) they were mentioned. A 1958 synthesis of work presented to corporate marketers discusses contributions of both the rural sociologists and the Columbia researchers (Foundation for Research on Human Behavior, 1959). By 1959, the rural sociologists began including Katz and Lazarsfeld's work in their bibliographies. Table 2 shows the cross-citations of the two schools of research. Although we have examined much of the published diffusion literature, the gap between actual conceptual or field work and publication makes it difficult in some cases to know exactly when some of the integration occurred.

In 1960, in separate works, both Lionberger and Katz sought to link the generalizations that had been developed by the two groups of researchers. Katz, specifically with respect to the generalizations about the role of information in the process of making either political or agricultural decisions, noted that a "convergence has already revealed a list of parallel findings which strengthen theory in both [areas]. . . In both urban and rural settings personal influence appears to be more effective in gaining acceptance for change than are the mass media or other types of influence" (Katz, 1960, p. 439). The work of Lionberger and Wilkening is cited alongside Katz and Lazarsfeld. From that time on, studies from both areas of research have routinely cited one another. Many of the Columbia studies are now listed in diffusion bibliographies (see Rogers and Shoemaker, 1971; Rogers, 1983; 1995).

Table 2: Chronological Comparisons of Cross-Citations Between Rural Sociologist Subcommittee and Columbia University Researchers

Key Research: Subcommittee on Farmer Adoption: Citations of Columbia researchers	**Key Research: Bureau of Applied Research, Columbia University: Citations of Subcommittee Research**
1943: Ryan and Gross seminal study of the diffusion of hybrid seed corn	1948: Lazarsfeld, Berelson and Gaudet: *The People's Choice*; no mention of rural farm research
1962: Gross expansion of the 1943 study to 10 innovations makes no mention of Columbia researchers. 1952: Lionberger review of literature; no mention of Columbia research; 1952: Wilkening North Carolina Bulletin 98 study; no mention of Columbia empirical studies	
1954: Bohlen and Beal give their first flannel board presentation including the new discrete generalizations	
1955 (November): Subcommittee publishes generalizations and initial bibliography; no mention of Columbia work 1955: Coleman and Marsh cite Lazarsfeld and Berelson, but only as examples of recent communication research. They made no parallels with the work of rural sociologists.	1955: Katz and Lazarsfeld publish *Personal Influence*; no mention of rural farm research or Subcommittee
1956: Wilkening Social Forces journal article cites 1948 People's Choice book; 1956: Everett Rogers attends conference in New York and meets Columbia group.	1955-56: Menzel and Katz drug diffusion article explicitly cites Wilkening, Lionberger and Marsh and Coleman studies, and concludes that "these studies are excellent representatives of a research tradition of the greatest importance for students of communication."
1957: Beal and Rogers (1957) article testing generalizations; no mention of Columbia group	1957: Katz explicitly cites Ryan and Gross, and Marsh and Coleman in this 2-step flow article 1957: Coleman, Katz and Menzel (1957) medical diffusion study: no mention of rural sociology studies, but this study focuses on group influences on doctors
1958: Rogers and Beal (1958) article testing generalizations cites both the Columbia 1948 and 1955 books in support of importance of social groups 1958: Foundation for Research on Human Behavior includes a synthesis of research from both the rural sociologists and Columbia researchers.	
1959: 2nd Edition of Subcommittee Bibliography cites 1955 *Personal Influence* book and Kurt Lewin	
1960: Lionberger book on diffusion has citations of 1948, 1955, and Coleman, Katz and Menzel medical study; plus other studies that form the base for the Columbia research; he integrates Columbia studies in discussions of influence and social status. 1960: Beal and Rogers Ag Experiment Station Report No. 26 mentions 1948 book	1960: Katz publishes review of literature explicitly including farm diffusion studies as part of "rediscovery" of importance of social groups, and attempts to integrate generalizations from the two areas.
1962: Rogers first book explicitly integrates Columbia University work into diffusion studies	1961: Katz compares Ryan and Gross hybrid seed corn study with the Coleman, Katz and Menzel medical study and uses both to develop joint generalizations

In his 1979 review, Chaffee (1979: 1) recognized how powerful and long-lasting the generalizations had become in the field of human communication.

> "One of the most durable policy generalizations derived from research on human communication is that interpersonal influence is more efficacious than mass communication in bringing about social change. Campaigns, corporations, and even countries are advised that mass media, while perhaps necessary to achieve economies of scale, are inferior to real, personal contact as a means of persuading people to change their behavior. Of course, no one sophisticated in the research literature would make such a sweeping statement unhedged by limitations, exceptions and caveats. But in transliteration from academic reviews to the more streamlined advice that circulates in communication planning circles, the image of powerful interpersonal processes comes through with unmistakable clarity."

What becomes clear is that the newly-designed generalizations were guided by the paradigm of the importance of personal communication with a focus on influence. Chaffee, in his 1979 critique of the generalizations, argued that both diffusion and the two-step flow researchers were led to conclusions that supported their interpersonal paradigm. Chaffee found that although the

1940 Lazarsfeld, Berelson and Gaudet (1948) study was considered a classic reinforcing the importance of interpersonal communication, in fact:

> "the original data… reveal that the media – even in that pre-television era – were judged more powerful by most voters. A slight majority cited either radio (38%) or newspapers (23%) as the most important single source in making their voting decisions… About one-half of those who changed their voting intentions during the campaign cited something learned from either the newspaper or radio as the main source of change. On the other hand, less than half mentioned any personal contact as an influential source, and less than one-fourth considered an interpersonal source as the most important one" (Chaffee, 1979, p. 8; Chaffee, 1982, p. 66). Chaffee's conclusion: "Apparently the emphasis on interpersonal influence emanating from the Erie County study was due more to the contrast between these figures and the researchers' expectations for far more dramatic evidence of media impact" (p. 9).

(While Chaffee's conclusion here about expectations is probably correct, it should be noted that media use was assessed for every respondent, while interpersonal source use was volunteered by respondents. This would tend to understate interpersonal mentions).

Similarly, for both diffusion and two-step flow theorists, Chaffee criticized an approach that sought to find the "most influential" communication channel.

> "Just as frequency of use is not a valid criterion for inferring higher credibility or preference for a channel, neither is recalled influence a valid criterion for concluding that one channel is capable of achieving stronger effects than another. … wise utilizers of information rarely rely on mass media alone; they do well to check with experts, compare notes with peers, and otherwise attempt to validate media content for themselves before acting upon it" (Chaffee, 1979, p.9).

Studies Supporting the Discrete Function Generalizations about the Role of Information Across Stages.

The discrete function generalizations developed by Bohlen and Beal were conceptually new, and at the time they found their way onto the flannel board and into the first Subcommittee report, they had not been empirically tested. The first two studies designed to test them were conducted by Beal, Bohlen and Rogers in 1956 using 148 farm husbands and wives in central Iowa (Rogers and Beal, 1958; Beal and Rogers, 1960; Beal and Rogers, 1957). Both studies found that mass media were the source of awareness for new fabrics, 2-4D herbicide spray, and animal antibiotics, while friends and neighbors were most frequently mentioned as the source of information at the "acceptance" or "persuasion" stage of the process. It was also noted that mass media and "cosmopolite" (expert, non-local) sources played a more important role for innovators and early adopters than for those who adopted later.

By 1960, Lionberger (1960) counted two additional supportive studies (Copp, Sill and Brown, 1958; and Lionberger, 1958). In 1971, when the most exhaustive list of studies to date was assembled by Rogers with Shoemaker (1971), a total of 21 studies were cited in support of these generalizations. However, when duplication is removed (several studies report results of the same piece of research), only 14 empirical studies remain. Two additional studies were found by Rogers with Shoemaker not to support the generalizations.

In support of one of the most extreme implications of the discrete function role of information sources, Rogers (1995) cites a key study by Sill (1958; Copp, Sill and Brown, 1958) of dairy farmers in western Pennsylvania. In that study, the conclusion was that "if the probability of adoption were to be maximized, communication channels must be used in an ideal time sequence, progressing from mass media to interpersonal channels (Sill, 1958). Copp, Sill and Brown (1958: 70) found "a temporal sequence is involved in agricultural communication in that messages are sent out through mass media directed to awareness, then to groups, and finally to individuals. A farmer upsetting this sequence in any way prejudices progress at some point in the adoption process." They concluded: "The greatest thrust out from the knowledge stage was provided by the use of the mass media, while interpersonal channels were salient in moving individuals out of the persuasion stage. Using a communication channel that was inappropriate to a given stage in the innovation-decision process (such as an

interpersonal channel at the knowledge stage) was associated with later adoption of the new idea by an individual because such a channel use delayed progress through the process." (It should be noted here that Copp, Sill and Brown (1958) classified "printed extension" information as a mass medium, while Sill (1958) in his Ph.D. thesis using the same dataset classified "printed extension" as a "Technician," not a mass medium. The difference is important since this was a frequently-mentioned source. Since the use of sources such as either printed extension materials or oral extension agents was highly associated with later adoption, this is an important difference.) This example also demonstrates the interest of researchers in converting their findings into specific recommendations for practitioners.

Rogers with Shoemaker conducted a comparative analysis of the role played by mass media and cosmopolite-interpersonal channels by stages in the innovation-decision process for 23 different innovations (mostly agricultural) in the United States, Canada, India, Bangladesh, and Colombia. They concluded:

> "Mass media channels are of relatively greater importance at the knowledge stage in both developing and developed countries, although there was a higher *level* of mass media channel usage in the developed nations, as we would expect. Mass media channels were used by 52 percent of the respondents in developed nations at the persuasion stage, and 18 percent at the decision stage. The comparable figures for respondents in Third World nations were 29 percent and 6 percent. This

> meta-research showed that cosmopolite-interpersonal channels were especially important at the knowledge stage in developing nations" (Rogers, 1995: 196).

Studies Supporting Alternatives to the Discrete Function Approach

There was evidence in the empirical studies suggesting that there might be alternatives to the discrete function generalizations involving multiple media use, and some studies – including the seminal Ryan and Gross study – did not support the discrete function generalizations. It should be emphasized that the generalizations put forward by the Subcommittee did come with some caveats concerning their application:

> "Some studies, such as that of hybrid seed corn, indicate that salesmen are important in creating awareness of new ideas which involve the use of commercial products. Neighbors and friends are important creators of awareness of new ideas among the lower socio-economic groups" (Subcommittee for the Study of Diffusion of Farm Practices, 1955: 4).

One source of ideas for an alternative approach to discrete functions came from studies concerning the first type of generalizations – those predicting higher use of information sources of all types by earlier adopters. Those studies found a significant relationship between high information seeking from many different sources and adoption of specific innovations (Abell, 1951; Bowers, 1938; Dimit,

1954; Lionberger, 1955; Marsh and Coleman, 1954; USDA Vermont Study, 1947; Wilkening, 1950; Wilson and Trotter, 1933). Other studies found high levels of general information seeking about general agricultural topics rather than specific innovations also were associated with high levels of adoption (Coleman and Marsh, 1955; Dickerson, 1955; Lionberger, 1951). The high reported use of all information sources suggested that multiple sources might be operating at later stages of the process.

Wilson and Trotter (1933), in reporting on farmers' adoption of improved legumes and other practices in three Missouri counties, found that the more exposure one reports to messages about legume practices from any source, the greater the chances for adoption (Table 17, p. 32). Lionberger (1951) found in a study of low-income Missouri farmers that " … compliance with each of the approved practices is positively associated with the number of personal, reading, and radio sources of information recognized by the households. This indicates the desirability of a multiple approach to the problem of reaching low-income farmers with educational materials." Coleman and Marsh (1955) found high adopters from a list of 21 innovations ranked higher in their use of every single information source (pp. 98-99). Coughenour (1960) also found a positive correlation between the use of both institutionalized sources and print media and adoption of an innovation.

The discrete function generalizations suggested single information channels were effective at different stages. This led to methodological

approaches that precluded looking for multiple channels. The desire to identify the single most influential channel led to a methodology that permitted only one response per stage. For example, the typical question at the evaluation stage asked, "After you had enough information to know quite a lot about [innovation], where or from whom did you get the information that helped you decide whether or not to actually try it out on your own farm?" (Rogers, 1957). The approach assumed that there was a single source of most influence since most often only one response was permitted. The same method was used across all stages, resulting in a matrix with one information source named per stage. When the 1957 and 1958 studies found that the one source named at the awareness and information stages tended to be mass media, and friends and neighbors were named at the evaluation stage, the generalizations were seen as being supported. The possibility of multiple channel use or interactions among media at a single stage could not be considered. This methodology was used in spite of the fact that some of the researchers were well aware that more than one source of information was being used at a stage. Wilkening (1956:34) observed that:

> "The low percentages giving the mass media for help in decision making and in the action stages of adopting changes does not mean that farmers do not obtain some help from them. The question elicits responses with respect to the most usual source for the different types of information and not with respect to the use of a source of information."

Changing the methodological approach in studies in which information-seeking behavior was examined across stages also changed the conclusions. Copp, Sill and Brown (1958) used a methodology that permitted farmers to mention more than one source per stage. They found that farmers did name multiple sources (an average of 1.6-2.0 for the awareness stage). However, it is difficult to make precise comparisons since their case study approach did not specifically ask farmers to name an information source or sources for each stage. In addition, for one of their three innovations, only 13% had moved beyond the information stage of adoption, limiting possible generalizations about the sequential use of various sources. The researchers found that farmers sometimes passed through a stage without indicating fresh sources of information. "In other words, earlier sources often possessed sufficient momentum to carry the farm operator through a number of later stages" (Copp, Sill and Brown, 1958: 149).

Coleman, Katz and Menzel (1966:56) used a methodology that focused on the order of use of media and the purposes for which they were used. While no attempt was made to place the use of media across the five stages of the process, they concluded: "the main point is that the decision to adopt gammanym (tetracycline) was based on a variety of sources of information."

In one of the studies most strongly questioning the discrete function generalizations, Mason (1962) assessed information source use independently of the usual battery of adoption stage questions. He used a series of scalable items

to determine a person's adoption stage and then attempted to match patterns of information source use to persons at each stage. This approach permitted multiple information source responses for each stage. One finding was that mass media use increased across stages. Lionberger found that mass media (radio) was an important source of influence at both the early and late stages in the adoption process, and that television was capable of activating viewers to adopt. However, despite the fact that this finding was reported along with a summary of the classic diffusion articles, there was no change in the generalizations as a result (Foundation for Research on Human Behavior, 1958). Tichenor, Donohue and Olien (1980: 159) in a study of public knowledge of local conflict-filled issues in two Minnesota regions found that newspapers were the primary initial source of information named. At a later time period, they found that the use of interpersonal sources had increased, but the use of newspapers had not declined. Both were about equal.

These studies indicate that, given the opportunity, respondents do tend to name a number of sources at each stage, and at least in some the number tends to increase as one moves through the process. In addition, a number of the studies downplay the relative importance of finding a single important source. Instead, they emphasize the contribution of many sources. Katz (1961:78), in a synthesis of both agricultural and medical diffusion studies, concluded that "in fact, it may be that the search for the 'most influential' medium is a fruitless one. It would seem that the focus should be the different uses of the media in varying social

and psychological circumstances." In a more recent critique of the Subcommittee's view, Chaffee (1979; p. 21) argued that "to think in terms of competition between media and interpersonal channels is to misdirect one's attention from the most important factors governing the flow of information."

Recall of Information Seeking Activity

A final problem of the seminal studies for information seeking is that they are based on recall of information over a long period of time. The typical study looking at information source use at different stages of the adoption process began after many farmers had adopted, and asked respondents to reconstruct their information-seeking behavior over time periods as long as 30 years (Deutschmann and Fals-Borda, 1962) or even 50 years in the case of one of several innovations studied by Lee (1967). Ryan and Gross (1943, 1950), in one of the earliest and most influential studies, found that most farmers learned about hybrid seed corn in the period 1929-1931, yet did not adopt until 1936-1939. The survey was conducted in 1941, an average of 7 years after first knowledge and several years more after adoption for most farmers. Could farmers accurately recall where they first heard about hybrid seed corn after all those years? Ryan and Gross looked only at the first source of information, and most influential source. They report a residual category of "all others" which includes "unknown" of 9.1% for original knowledge and 7.0% for most influential. When

five stages of the process are examined, would this likely increase the difficulty of recall?

Beal, Rogers and Bohlen (1957: 167), in justifying the validity of their five-stage model of the adoption process, reported that "farmers seemed to have little trouble recalling when they became aware of, tried, and adopted the practice and their sources of information at each stage." They noted that their data for the diffusion of 2,4-D and hog antibiotics contained "very few 'don't know' answers."

Other studies, however, do report some recall problems. Wilkening (1956) asked young Wisconsin farmers about their first source of information about new ideas in farming, their source of information that "helps you decide," and their source of information on "how much" or "when" to use the innovation. He found: "In obtaining responses to the questions used here there was some difficulty in getting respondents to distinguish between the three different types of information. This was particularly true for the second and third questions" (p. 363). One difference between this study and Beal et al. was that Wilkening was asking about a general topic – new ideas in farming – while Beal et al. were asking about specific innovations.

A second study (Lee, 1967) studied specific innovations, but also found that both low and middle-income Missouri farmers said they had trouble remembering sources of original information for some of the innovations. For some innovations, in fact, "I can't remember" was the most frequent answer

given. Dramatic differences were found between low-income respondents who were the target of intensive Extension outreach efforts, and middle or low-income farm groups that were not intervention targets. Results ranged from a high of 44% saying "I can't remember" or "I don't know" for non-intervention middle-class dairy farmers to approximately 25% for middle class hog producers, low income non-intervention dairy farmers, and low-income non-intervention hog producers. For respondents in the intervention group, the "I can't remember" response was only 4%.

Rogers (1995: 122) offers this critique of the recall approach:

> "One weakness of diffusion research is a dependence on recall data from respondents as to their date of adoption of a new idea. .. This hindsight ability is not completely accurate for the typical respondent (Menzel 1957; Coughenour, 1965). It probably varies on the basis of the innovation's salience to the individual, the length of time over which recall is requested, and on the basis of individual differences in education, memory, and the like.
>
> "Diffusion research designs consist mainly of correlational analyses of cross-sectional data gathered in one-shot surveys of respondents (usually the adopters and/or potential adopters of an innovation)... If data about a diffusion process are gathered at one point in time, the investigator can only measure time through respondents' recall, and that

> is a rather weak reed on which to base the measurement of such an important variable.
>
> "More appropriate research designs for gathering data about the time dimension are: (1) field experiments, (2) longitudinal panel studies, (3) use of archival records, and (4) case studies of the innovation process with data from multiple respondents (each of whom provides a validity check on the others' data)…. Unfortunately, alternatives to the one-shot survey have not been widely used in past diffusion research."

An improved study design to reduce the threat to validity of the recall problem would call for a longitudinal study, with farmers measured at multiple points as they pass through the adoption process. In this way, farmers would be recalling source use over a much shorter time period, and patterns in their responses would be evident over time.

Revised Propositions Concerning the Role of Information in the Diffusion Process

Our first proposition concerns the overall pattern of use of information sources as one moves through the adoption process:

Proposition No. 1:

As one moves through the adoption process, information-seeking from all available channels increases.

Our basis for this proposition rests on three factors:

1. Studies of the first type of generalizations consistently found that the naming of many information sources is common, and that those who use multiple sources tend to move through the adoption process more rapidly.
2. Most studies permitting respondents to name more than one source per stage find that they do.
3. Mason's (1962, 1963, 1964) research found that naming mass media as a source increased across stages rather than decreasing, and the reported use of all sources increased across stages.

This proposition would require a methodological approach which permits respondents to name multiple sources of information at each stage of the adoption process.

Access to Information with Relevant Content

Because both the amount of information available about an innovation and the mix of sources carrying that information change over time, it is important to consider these changes when studying patterns of information source use. Also important is individual access to relevant sources. To some extent, attention to these factors can help shed light on differences in

information-seeking behavior by innovators and laggards. Two elements are involved here:

1. Access to Information Sources;
2. The Cycle of Media Content Relevant to the Innovation;

Access to Sources. Farm access to general media such as general farm magazines, radio, television, and newspapers has been found to be nearly universal by studies in the Midwest (Lionberger, 1951; Wilkening, 1953, 1956) and the Northeast (USDA Vermont Study, 1947). In the South, far wider variations in access to these media have been found (Coleman and Marsh, 1955; Yancey, 1982). In other countries, access is often a much more important variable. Rogers and Svenning (1969), for example, found that in rural Colombia few farmers had access to printed or broadcast messages relevant to innovations at any stage of the adoption process.

In the United States, access to specialized farm publications and services distinguish large and small farmers. The advent of controlled circulation farm publications that are sent only to farmers with certain crops and a minimum gross farm income has explicitly excluded smaller farmers. In these cases, small operators cannot receive these publications even if they are willing to pay for them. More significant are a variety of paid consulting and publication services that tend to be used only by large operators.

The Cycle of Media Coverage. Mass media tend to respond to news about innovations in much the same way as they respond to other forms of news. Often there is scattered and uneven coverage at first, followed by a time of peak coverage and intensive media interest. The innovation may become the "cover story" of magazines. After a time, coverage tends to decline (Abbott and Richardson, 1979). In a study of what they termed "the hoopla effect," Abbott and Eichmeier (1998) found support for the idea that there is a regular pattern of media coverage of technological innovations. Abbott and Yarbrough (1989) found that the period of maximum coverage about farm computers came earlier than the time when significant adoption was occurring. Tichenor, Donohue, and Olien (1980) found that during the times of peak coverage, widespread awareness of news content could be found at all educational levels of a community, and the gap between those who know the most and those who know the least decreased. However, both before and after this peak in coverage, knowledge gaps would be expected to increase between the two groups.

This pattern of coverage would be expected to be reflected in increased mentions of mass media at the peak times of coverage, and a decline in mentions at other times. Thus, it would be important to compare the time period or periods when respondents were questioned with media content at those same periods.

Another important aspect of media or information cycles relates to what Rogers (1995) terms the "pro-innovation" bias of many of the diffusion studies.

Technologies selected for diffusion studies are not random; in many cases they are technologies that are the focus of interest and effort by industry, government agencies, or some other interest groups. Coleman, Katz and Menzel (1966) who studied the introduction of tetracycline by a drug company, found that drug salesmen were the most common first source of knowledge. They concluded: "…the relative importance of different sources or channels of communication about an innovation depends in part on what is available to the audience of potential adopters. For example, if a new idea is initially promoted only by the commercial firm that sells it, it is unlikely that other sources or channels will be very important, at least at the knowledge stage of the innovation-decision process" (Rogers (1995), p. 192).

This leads to our Proposition No. 2:

Information-seeking behavior is conditioned by the development and behavior of message production and delivery systems.

Willingness to Use Sources

Beyond access, several other important factors shape the extent to which members of an audience utilize information sources. Differential use of information sources has often been explained in terms of personality variables,

with innovators much more eager to seek information and laggards clearly oriented to the past (Rogers, 1983). Scherer (1989) found that interest in using information sources of all types was closely related to socio-economic status. He explained this in terms of knowledge about how to control their information environment. Those who knew how to use information effectively use this ability across information channels. Rogers (1962:313) in his 1962 synthesis, put forward the generalization that "earlier adopters utilize a greater number of different information sources than do later adopters." Rogers attributed this to the fact that they have higher education, better abstract reasoning skills, and more ability and willingness to take risks.

Lionberger and Campbell (1971) found that when it comes to needing information, farmers go to the persons who are expected to be most knowledgeable, whether or not they are much like themselves. This tendency was found at every stage of the adoption process.

Although audience characteristics play an important role, the characteristics of the innovation itself may also influence channel use. Jain (1965) in a study often cited in support of the original generalizations, found that the type of source used depended on the innovation. For hybrid seed corn and a weed control chemical, farmers used neighbors and friends for information. But for a record-keeping system, they used cosmopolite sources. An earlier study in Vermont found much the same thing. For innovations first mentioned by the interviewers, farmers tended to mention outside or

cosmopolite sources, but for innovations that the farmers themselves first mentioned, local sources or "self" tended to be mentioned.

This leads to our Proposition No. 3:

For economically-rational innovations, individuals who are habitually high information seekers will adopt earlier and will use information from all sources more.

Information-Seeking Behavior After Adoption

One problem in studying information-seeking after adoption of an innovation is that the question originally asked of respondents at this stage was ambiguous. Beal and Rogers (1960) asked: "After you once tried (antibiotics or 2,4-D weed spray) on your farm, how did you decide whether or not to continue using and actually adopt it?" A more appropriate wording for this stage might have been: "Where or from whom did you get information about the innovation after you adopted it?" This would parallel how questions at other stages were asked. The answer most commonly received by Beal and Rogers was that the farmer looked at the results of a trial and decided to continue based upon his own evaluation. Bohlen and Beal (1957) reported that in more than 90 percent of their studies, individual satisfaction with the idea was the most important factor

in its continued use. Jain (1965), using the same approach as Beal and Rogers, got the same answer. An answer of "self" was difficult to compare with information-seeking responses at other stages, and as a result, the entire stage was often dropped from either the questionnaire or the analysis.

Beal and Rogers' (1957) companion study of adoption of new fabrics by housewives dropped analysis of the adoption stage. Neither Rogers nor Deutschmann and Fals-Borda included this stage in their Colombian studies (Deutschmann and Fals-Borda, 1962; Rogers, 1964; Rogers and Meynen, 1965; Rogers with Svenning, 1969). Mason (1963) did look at the communication behavior of farmers after adoption of an innovation. He found that in general, use of all sources increases as one moved across stages. However, there was an exception for high influentials after adoption, when use of mass media declined.

Recently, interest in what happens after adoption has increased. Rogers (1995) now refers to the adoption stage as a time of re-invention (adaptation of the innovation by the adopter) and confirmation (seeking reinforcement for the adoption decision). Rogers explains post-adoption information behavior partially in terms of a need to reduce dissonance. Cognitive dissonance research (Festinger, 1957) found that the highest levels of information seeking often occurred immediately following adoption, but he explained this as arising from a need to justify the adoption decision rather than a need to gather information about how to use the innovation.

Another possibility is that for computers and other general innovations that can do many things, questions about how to use or apply them become more salient after adoption. Books, manuals, dealers and other sources would be useful in answering these questions. Thus, some innovations may be associated with very high levels of information-seeking following adoption. Rogers implies this when he points out that "re-invention" is very likely for computers. Our proposition No. 1 already predicted a high level of information-seeking at the adoption stage. But in the special case of computers and other complex innovations, a unique proposition seems to be in order. While computers are an obvious example of an innovation with high post-adoption information seeking, we argue that many other innovations such as hybrid seed corn and minimum tillage agriculture probably follow the same pattern. In agriculture, for example, the adoption of hybrid seed corn was not a simple process, but involved consideration of changes in fertilizer, chemicals, planting densities, and storage issues. Thus, adoption of hybrid seed corn led to a significant increase in the need for information. Organic and minimum tillage agriculture are also complex innovations to implement.

This leads to our Proposition No. 4:

For innovations that are evolving internally or that are becoming more integrated with other practices, information seeking continues at a high level after adoption.

Using Information-Seeking Scores to Predict Behavioral Change

Proposition No. 1 predicts a positive correlation between one's stage in the adoption process and the total number of information sources being sought. One way of interpreting this finding is that as a person becomes more and more actively interested in an innovation, he or she is likely to seek out more and more information about it. Thus, at the awareness stage, one would expect a low level of information-seeking activity from any source. At the information or knowledge stage, more sources or more intensive use of existing sources would be expected. At the evaluation, persuasion or decision stages, when a respondent says he or she is seriously considering adoption, one would expect a very high level of information-seeking. Finally, a case has been made that after adoption of a computer or similar device, the rate of information-seeking would be expected to remain high.

Operationally, this means that if one were to follow information-seeking behavior of potential adopters over time, one would expect that those who exhibit little or no change in information-seeking would remain at their current adoption stage, and that those who raise their levels of information-seeking would move forward in the process by one or more stages. If our approach is correct, we would anticipate that a reduction in information-seeking activity should be associated with a backward movement in adoption. That is, a person at Time 1 who said he or she is seriously evaluating adoption of an innovation

might move backward to the knowledge stage at Time 2. The original diffusion model did not anticipate this type of movement. One interpretation, and the one adopted here, is that while the traditional diffusion approach would require either a static condition or movement to adoption or rejection, in fact there is some "temporary suspension" of thinking about an innovation, which might mean that the person continues to read about an innovation, but is not now seriously considering it. A second possibility is that these changes might be due to random error. However, if the information-seeking activity would also decline as a person reports backward movement, this would indicate not only that the error is not random, but would demonstrate the close relationship between information-seeking activity and stage in the adoption process. This leads to the Proposition No. 5:

An increase in one's information-seeking behavior tends to be associated with a forward movement to a more advanced adoption stage, while a decrease in one's information-seeking is associated with a backward movement.

The Longitudinal Dataset

Data for the preliminary test of the propositions is taken from a longitudinal study of computer adoption by Iowa farmers initiated by J. Paul Yarbrough at Iowa State University in 1982, and continued by Clifford Scherer and Eric Abbott. The research was funded by the Iowa State University Agricultural and Home Economics Experiment Station. The study consisted of

an initial panel of 1,000 randomly-selected farmers surveyed by mail in 1982, and then re-surveyed in 1984 and 1987; a second panel of 1,000 randomly-selected farmers surveyed by mail in 1984 and again in 1988; a third random sample of 1,000 surveyed in 1989; and a fourth random sample of 1,000 surveyed in 1997. The mail surveys used the Dillman (1978) Total Design Method, and resulted in return rates of between 65% and 75% (except for 1997, which had a return rate of 44%). By 1987 when the first panel had responded three times, it contained 303 farmers. The second panel, which responded for the second time in 1988, contained 440 farmers.

Each time the farmers were surveyed, they were asked two questions that are crucial for this analysis. First, they were asked to indicate where they were with respect to adoption of a computer. Following a classification similar to that developed by the original subcommittee, farmers were asked to indicate if they had given "little thought (awareness)" to computers, had sought "information" about computers (but not yet making any decision), were actively "deciding (evaluating)" whether or not to adopt, had actually "adopted," or had "rejected." Since the research began at a time when very few farmers had adopted, the problem of having to recall information from long ago was minimized. In addition, since these same farmers were surveyed repeatedly, it was possible to chart their adoption progress over a period of time. This avoids the problems with "one-shot" diffusion studies mentioned by Rogers.

The second variable was a series of questions concerning computer information seeking. Farmers were asked: "Within the past year, how often have you used the following sources to obtain information about computers?" There were 11 choices, which included both mass media and interpersonal sources.

Items were:

1. reading about them in magazines or newspapers;
2. reading books or computer manuals;
3. writing or telephoning for information from computer manufacturers or dealers;
4. visiting a computer dealer;
5. attending a computer exhibit or fair;
6. taking a computer short-course or workshop from a computer dealer, college or other organization;
7. attended an Extension meeting where part of the program was about computers;
8. talked with Extension staff about computers;
9. Talked with college or high school teachers about computers;
10. Talked about computers with other farmers who are using them;
11. Talked about computers with non-farm users.

For each item, respondents could indicate "never" (0), "once" (1), "twice" (2), "three times" (3), "four or more times" (4). A score was then

calculated by adding all computer information-seeking items, yielding a possible range of from 0 to 44. Unlike the early diffusion studies, the use of all information sources was assessed, and then compared to the respondent's adoption stage.

Test of Proposition No.1

As one moves through the adoption process, information-seeking from all available channels increases.

Three of the random samples of Iowa farmers (1982, 1989 and 1997) were used for this test so that information-seeking could be examined at several different time periods. The two variables, stage of the adoption process and computer information-seeking, were compared for each time period.

Results, Table 3, show that Proposition No. 1 is supported in every time period. In each case, total computer information-seeking increases as one moves through the stages of the process, and is highest for those who have adopted a computer.

Table 3: Total computer information-seeking behavior
By computer adoption progress: 1982, 1989, 1997 Iowa random samples

Adoption Progress Scale	1982	1989	1997
"Little thought"	4.5	4.6	4.3
"Rejected" or "Discontinued"	4.7	5.4	2.9
"Obtained Information"	9.5	10.1	8.0
"Deciding or Decided to get a computer"	14.8	13.5	11.9
"Adopted a computer"	18.2	19.1	12.9
F linear test	273.6 (p<.000)	386.1 (p<.000)	105.4 (p<.000)
F deviation from linear	7.2 (p<.001)	6.8 (p<.001)	3.0 (p<.05)
Correlation	.57 (p<.000)	.62 (p<.000)	.53 (p<.000)

These results have very high F values on a linear test, indicating a highly significant increase for every year. Deviation scores are also significant, but at a much lower level, indicating that the increases are not perfectly linear. Nevertheless, there remains a high correlation in each group between computer information-seeking and the stage of the process.

A more rigorous test of the proposition would divide computer information-seeking in the three time periods by whether or not the sources were:

1. Impersonal media (articles or books)
2. Expert sources (extension staff, dealers, teachers, etc.)
3. Friends or neighbors

For this test, the 11 items used to construct the overall computer information-seeking score were divided into the three categories. Only one – computer fairs – was eliminated, since a fair could mean contact with friends, experts, or media sources. The others were grouped as follows:

1. Impersonal media:

- Read articles in magazines or books;
- Read books about computers (or computer manuals)

2. Expert sources:

- Written or telephoned for information from computer manufacturers or dealers;
- Visited a computer dealer;

- Taken a computer short course or workshop from a computer dealer, college or other organization;
- Attended an Extension meeting where part of the program was about computers;
- Talked with Extension staff about computers;
- Talked with college or high school teachers about computers.

3. Friends and neighbors:

- Talked about computers with other farmers who are using them;
- Talked about computers with non-farm users.

Scores have been standardized across categories. Results indicate strong support for the proposition. Use of sources increases significantly for every type of information across each of the three time periods. Analysis of variance tests for linearity show highly significant results for all columns of the table. Deviation from linearity scores are much lower, but indicate that relationships are not perfectly linear in several cases, especially for experts in 1982 and 1989. Use jumps rather suddenly rather than increasing in a linear fashion. High and significant correlations exist for every column of the table. The original generalizations would suggest that the use of mass media would decline as one becomes more serious about adoption, and that the use of friends and neighbors and expert sources would increase. Results, Table 4, show that information-

seeking scores for all three categories increases as one moves across the adoption process. This supports Proposition No. 1 for all information sources.

Table 4
Mean Computer Information-Seeking by Source for 1982, 1989, and 1997 Iowa Random Samples

	1982			1989			1997		
	Media	Experts	Friends	Media	Experts	Friends	Media	Experts	Friends
Little Thought	2.5	.5	1.2	1.9	.4	1.4	1.5	.6	1.6
Rejected	2.3	.8	1.2	1.8	.7	1.7	.9	.3	1.3
Know-ledge	4.2	1.8	2.8	3.3	1.9	3.0	2.6	1.0	3.2
Decision	5.4	4.6	3.5	4.0	3.2	4.1	3.6	2.8	3.9
Adoption	6.8	6.7	3.8	5.6	6.1	4.5	4.0	3.2	3.8
F Linear test	147.3*	262.5*	95.1*	219.8*	330.0*	191.6*	67.6*	66.4*	56.6*
F Deviation from linear test	4.9*	14.0*	2.0	7.3*	35.8*	2.5	2.4	1.8	2.7*
Correlation	.46*	.56*	.39*	.52*	.59*	.49*	.44*	.44*	.41*

* Significant at <.05

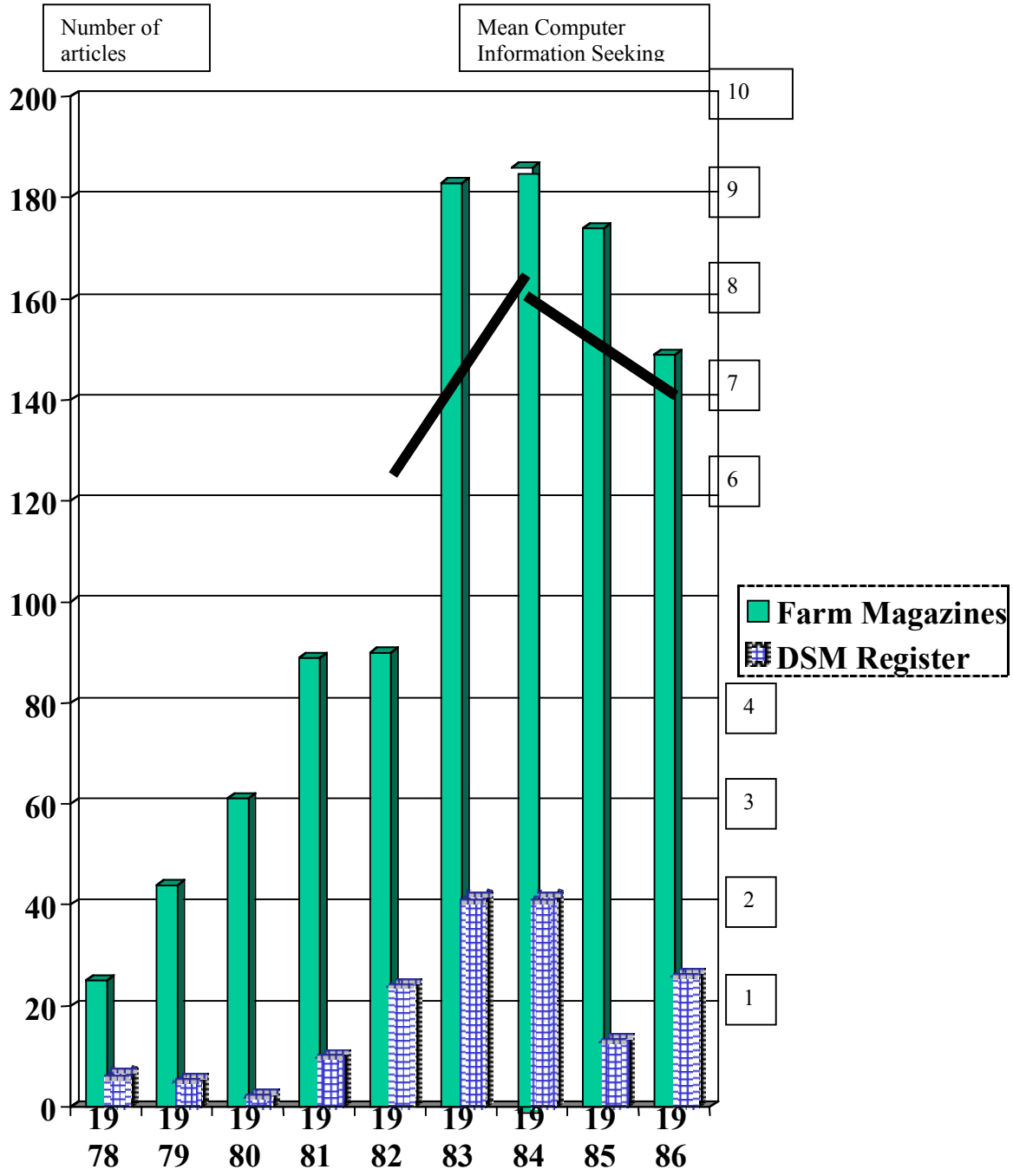
The reported use of a number of information sources does not indicate the value that might be placed on any one source, or the synergistic effect that might be brought about by the use of multiple sources. However, it is strongly suggestive of the fact that printed or impersonal media sources do not lose their importance as one moves through the adoption process.

Proposition No. 2

Information-seeking behavior is conditioned by the development and behavior of message-production and delivery systems.

This proposition deals with the message-production and delivery systems. In the tables testing Proposition No. 1, three different time periods are shown. A re-examination of the tables shows that the computer information-seeking scores decline across time for all types of sources. The availability of relevant media coverage could be expected to influence media use. Agenda setting theory, for example, has found a strong relationship between the amount of material in the press on a given topic and the public's ranking of the topic as being important or not important. The main emphasis of the current research was not on patterns of media coverage. However, during the initial period of computer diffusion, from 1978-1986, we conducted a content analysis of coverage of farm computers by farm magazines and the *Des Moines Register*. The results show a peak in coverage in 1983-84, which was a period of optimism about the future of farm computers. Two years later, the farm economy was in recession, and a number of new farm computer magazines went out of business. Figure 1 shows the pattern.

Coverage of Farm Computers by Farm Magazines
and the Des Moines Register: 1978-1986



Media coverage patterns would indicate that the greatest likely use of information about farm computers would have occurred in the 1983-1984 peak, and would have declined somewhat thereafter. Unfortunately, a complete dataset showing what media provided after 1986 is not available. However, we can look at media use patterns by farmers during this time period using the panel that was surveyed in 1982, 1984, and 1987. Since these are the same individuals, we can control to an extent for differences across groups. In general, panel studies show an increase in scores over time as less willing or able individuals cease responding. However, as Table 5 shows, in this case the data support our proposition, especially for the mass media coverage. The 1984 group – matching the height of the media hoopla about farm computers – in general shows the highest computer information-seeking scores for media and experts, but not friends/neighbors. The analysis of variance test for linearity is not significant, but the significant quadratic test for a curvilinear relationship confirms that the 1984 year is higher (this is what we predicted). By 1987, when the farm depression hit and media coverage of farm computers declined, information-seeking scores declined for the knowledge, decision and adoption stages for almost all categories (the one exception again was the decision stage for friends). The tests for experts and friends are not as clear (but the proposition deals mainly with mass media). Use of experts is significant in both linear and quadratic tests, indicating that use of experts overall increased across time, and their use in 1984 was also highest. For friends, results show a linear trend,

indicating a steady increase in interpersonal communication over time. Tichenor, Donohue and Olien (1980) have found a close relationship between media coverage levels and interpersonal discussion and learning. Media tend to stimulate discussion.

Table 5: Trends in computer information-seeking
Iowa Panel No. 1: 1982, 1984, 1987

	Year			F value	
Source	**1982**	**1984**	**1987**	**Linear**	**Quadratic**
Media	3.0	3.4	3.1	1.53 n.s.	4.01 ($p<.05$)
Experts	1.2	2.3	2.0	23.7 ($p<.000$)	16.8 ($p<.000$)
Friends	1.6	2.3	2.5	34.6 ($p<.000$)	2.0 n.s.

Proposition No. 3

For economically-rational innovations, individuals who are habitually high information seekers will adopt earlier and will use information from all sources more.

Since this proposition is not in conflict with the body of findings from previous diffusion studies, no test of it is provided here. Existing diffusion literature has consistently found that those with high education seek out more information and adopt earlier. Part of the reason why information-seeking scores tend to decline over time is that innovators and early adopters tend to be well-educated, and thus are adept at seeking information from many different sources.

Proposition No. 4

For innovations that are evolving internally or that are becoming more integrated with other practices, information-seeking continues at a high level after adoption.

Our longitudinal study was of the adoption of computers, and results support the proposition. Information-seeking scores found among adopters in Tables 3, 4 and 5 were consistently the highest of any group across all types of information-seeking. This includes information-seeking from media sources, experts and friends/neighbors. The tendency of adopters to seek computer information is not limited to recent adopters. In fact, our 1997 dataset shows that those who adopted computers before 1990 have computer information-seeking scores (15.3) that are slightly higher than those who adopted in 1990 or later (13.1). Rogers explained information-seeking following adoption as being due in part to dissonance, with information-seeking occurring to allow the purchaser to justify the decision. However, long-term information-seeking patterns such as those shown in our data would be difficult to explain using dissonance theory. The pattern shown here suggests information-seeking for answers to questions about how to use the machine effectively and master new applications.

Because it is possible that computers form a special case, this proposition should be tested with a number of different types of evolving innovations. As mentioned earlier, it is our position that high post-adoption information-seeking would be found for many innovations.

Proposition No. 5

An increase in one's information-seeking behavior tends to be associated with a forward movement to a more advanced adoption stage, while a decrease in one's information-seeking is associated with a backward movement.

The focus of interest for testing this proposition is on the change across time between an individual's adoption stage and his or her information-seeking score. To test this, paired comparisons between the status of respondents at one point in time with another were made. For the first panel, two time periods could be compared – the change between 1982-1984, and between 1984-1987. For the second panel, one time period, 1984-1988, could be compared. This yielded two paired comparisons of 303 each for the first panel, and 440 for the second, for a total of 1044 comparisons.

Each comparison could fit into one of three categories:

(1) No change: the respondent might not have changed adoption stages between the two time periods. For example, a respondent who said he was at the information stage at time 1 and was still there at time 2 would be classified as no change;

(2) Forward Progress: the respondent has moved forward, for example from the awareness stage to information, evaluation or adoption; or from evaluation to adoption;

(3) Backward Progress: the respondent has moved backward, for example from evaluation back to information.

Based on their categories, respondents were then placed in cells in a matrix. For each cell, the mean computer information-seeking score was calculated, as well as the change in score from time 1 to time 2. The results are shown in Table 6 below.

Table 6:
Change in Information Behavior
By Change in Adoption Stage

		Before			
		Aware	**Information**	**Evaluation**	**Adoption**
After	**Aware**	5.3 **0.14**	6.0 **-1.64**	10.5 **-8.99**	9.7 **-7.21**
	Information	6.8 **0.06**	8.3 **-2.44**		
	Evaluation	13.7 **2.51**		14.8 **-1.91**	
	Adoption	16.9 **4.36**			19.5 **-3.33**

N=1044 paired comparisons
Pooled Iowa Panels: 1982-1984; 1984-1987; 1984-1988
Top Number in each cell is the mean computer information-seeking score
Bottom Number in each cell is the change in computer-information-seeking between Before and After.

First, we examine the characteristics of individuals in the first group – who have not changed their adoption status. These respondents are found in the band of cells from top left to bottom right of the table. These are individuals who were in the awareness stage "before" and are still there "after," the Information stage before and after, etc. The mean computer information-seeking scores show the same trend that we saw in our earlier analysis of the random samples – as one moves from awareness through information, evaluation and to adoption, computer information-seeking scores climb. The second figure, in boldface,

shows the change in scores. Note that the scores become slightly negative across time. One reason for this slight negative trend was shown when testing Proposition 2. As mass media coverage declines somewhat over time, use of sources declines.

The second group, those who have made forward progress are shown in the dark box at the bottom left of the table. For example, those who were only aware "before" and are now at the information stage "after" are shown in the box at the top of the darkened area. Figures are also shown for movement to evaluation and adoption from lower "before" stages. Note that once again, mean computer information-seeking scores rise as one moves to more advanced adoption process levels. More importantly, the change score is positive, and becomes more positive as one moves through information to evaluation and then to adoption.

The third group, those who have moved backward through the process, are shown in the dotted area at the top right of the table. These individuals now report that they are at an earlier stage of the adoption process than they were when first measured. Note that the change score for individuals in this group is negative, and for those moving from adoption and evaluation to a lower stage, it is very negative.

These results offer strong preliminary support for our proposition. Changes in information-seeking behavior are closely associated with actual changes in adoption progress. And the changes may be positive or negative.

Conclusions

There have been several previous critiques of the diffusion theory generalizations dealing with the role of information in the adoption process, including Chaffee's 1979 paper and critiques by diffusion scholars themselves. This paper goes beyond these earlier critiques in two important respects. First, it develops four new propositions designed specifically to redirect attention to important areas of information-seeking that have not been adequately investigated by diffusion researchers. Second, it tests the propositions using a longitudinal dataset designed especially to measure multiple channel information-seeking and adoption behavior over time.

Four New Propositions

Multiple Sources

By presenting information-seeking as an additive process rather than a discrete process, our approach attempts to redefine the paradigm about the role of information-seeking in the diffusion process. Once an additive approach is followed, research can begin on synergistic ways in which adopters use information sources simultaneously. Both the Columbia researchers and the members of the subcommittee were interested in the roles of different media

channels (impersonal vs. personal), but this emphasis on a discrete approach (that mass media inform and friends persuade) obscured the ways in which people use many media sources for similar purposes.

The additive approach conceptualizes the initial source as a product of the pattern of use of information sources by adopters. Whatever channel is customarily available that carries new information will be used. In the classic hybrid seed corn study (Ryan and Gross, 1943), it was salesmen. In the Columbia researchers' medical innovation study (Coleman, Katz and Menzel, 1966) it was drug detail men. In Sill (1958), it was Extension – an agency that was dedicated to reaching farmers with new information on specific innovations. Similarly, where mass media are widely available and carry relevant content, they are often named as the initial source (Beal and Rogers, 1957, Rogers and Beal, 1958). Where mass media are not widely available, as in many developing countries, interpersonal sources are found to be the key initial source (Rogers and Svenning, 1969; Deutschman and Fals-Borda, 1962).

Once there is interest in an innovation, which is likely to be caused by both available information and a cognitive realization that an innovation might be useful, there is a dramatic acceleration of information-seeking from all sources perceived to have useful information. Chaffee (1979) suggested that information consumers typically cross-check sources to verify and validate information. Tichenor, Donohue and Olien (1980) find that when information saturation occurs in communities about a relevant local topic, considerable learning takes

place among all socio-economic levels, and there is a significant relationship between interpersonal communication and learning from newspapers and other media. Chaffee and Choe's (1980) study of voting behavior shows that campaign deciders wake up to the fact that it is time to pay attention to the campaign about a month or two before the election, and begin to use both interpersonal and mass media sources. Pre-campaign deciders, on the other hand, attend to multiple information channels almost from the beginning and continue to use them throughout the campaign.

How audiences utilize multiple information sources to make sense of what an innovation offers, how they evaluate what is a credible source and what is not, and how the totality of information is used to reach a decision would be a productive new area for diffusion research. In the area of computers, computer magazines that offer detailed information and comparative performance trials might be considered more valuable in the decision process than the fact that a neighbor or friend happens to be using a computer, although surely potential adopters would check both. Kosicki's (1990) notion that people's history with information channels leads to development of framing strategies that guide subsequent source use and evaluation is an example of where this research might lead.

Shifts in Mass Media and Interpersonal Content

The idea that there is a constantly-shifting pool of information and media about an innovation – with a hoopla period or waves of coverage – suggests that

much more attention should be paid to the patterns of provision of information across time. Rather than being viewed as a constant, with differential use being attributed to personality factors (innovators versus laggards), seeing the information system as dynamic refocuses attention on what was available at any given point in time, and what audiences were stimulated to talk about. Early adopters tend to adopt during hoopla periods when there are many different sources of information available and considerable interpersonal discussion. Is it surprising that evidence shows that they use them? Laggards, coming later, find information channels carry less information. At the same time, as more and more people have adopted, it is more likely that laggards will encounter someone who has adopted or knows about the innovation. This would explain why laggards tend to use such interpersonal sources.

The discussion here is not intended to suggest that all differences can be accounted for by change in the types of information available. We agree with the strong evidence frequently cited in diffusion literature showing that education is a powerful force shaping patterns of attention and use of information sources. Our assertion is only that information channel content is dynamic and should be studied along with education and other factors.

Information-Seeking Following Adoption

Diffusion researchers have already begun to focus on the adoption and post-adoption stages of the process (adoption, re-invention, confirmation – see Rogers, 1995). Our contribution here is to suggest that for innovations that are

evolving internally or complex, information-seeking is likely to continue at a high level for some time. Our computer data show that information-seeking levels remain high for up to 20 years following adoption --higher than any other stage of the adoption process. This is a long-term area of information use that needs to be studied further. Although Rogers' (1995) notion that dissonance theory might explain some of the information-seeking that goes on following adoption, our evidence indicates that there must be much more going on than that. Rogers (1995) development of the "re-invention" and "confirmation" stages represents an important step in studying post-adoption behavior.

Many innovations, such as taking a long-term drug for a heart or bone density condition, organic farming, or changing to low-fat cooking, are actually complex in their ramifications and probably stimulate long-term information-seeking behavior. Although more study is needed, we expect that computers are not unique in high information-seeking after adoption.

Forward and Backward Progress

The proposition concerning forward and backward adoption progress of people over time, and the close relationship between patterns of innovation information-seeking and changes in adoption stage, suggest that information-seeking can to some extent be taken as a barometer of adoption progress. When levels increase, forward progress is likely (although rejection is also possible). When they decline, suspension of interest or even discontinuance may occur.

The pattern strongly supports the notion that adoption is related not to the use of any one type of information source (e.g. interpersonal) but to use of the whole spectrum of information sources.

Backward progress illustrates the need for study of the dynamic process by which people are activated to consider adoption and then lose their interest. Although not shown in the figure presented, we found that "rejection" is a dynamic phenomenon – today's rejecter may be tomorrow's adopter. Rejection, which in some few cases actually is the result of a carefully considered decision, is more often a statement of not wanting to think about an innovation. That is why information-seeking scores associated with rejection are so similar to the "little thought" group scores.

Instead of a one-way linear process, we now see the adoption process as potentially containing a number of periods of interest followed by periods of inactivity, initial rejection followed by information-seeking followed by yet another rejection, or adoption followed by discontinuance. Changes in individual circumstances, such as receiving a substantial tax refund, may set in motion information-seeking and adoption behavior that had been inactive for some time.

A Revised Methodological Approach and Longitudinal Study

The second contribution of our research has been to go beyond criticism of the original generalizations, and to develop and test a methodology for the alternative propositions. Characteristics of the revised methodology include:

- A combination of panel and random sample surveys taken over the period of diffusion of the innovation;
- Questions that document both the adoption progress stage and innovation information-seeking at every survey point.

The approach addresses a number of criticisms that Rogers (1995) has made of existing diffusion datasets, including the problems of recall over long periods of time and reliance on one-shot surveys. It also measures post-adoption information-seeking behavior, up to 20 years after the innovation was adopted.

Our dataset is somewhat unique, in that it began when computers first became commonly available and has now continued through the innovator (2.5%), early adopter (13.5%) and early majority (34%) stages using both panel and random samples. Panel data have permitted us to examine specific changes in individual behavior over time, while the random samples have provided estimates of overall adoption progress and information-seeking at regular points in time. Such datasets are needed to move diffusion research beyond its current level.

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