MULTIVARIATE CAUSAL MODELS OF INFORMATION FLOW IN RURAL BRAZIL

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This is to certify that the

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ABSTRACT

MULTIVARIATE CAUSAL MODELS OF INFORMATION
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By

John J. Kochevar

On the basis of prior research and theory a hypothetical developmental model was created with the following components: Access factors--variables indexing the number of messages available to the receiver; Exposure factors--variables measuring amount and type of exposure to personal and mass media sources; Receiver factors--variables directly influencing individual information seeking and utilization; Knowledge--measures tapping information gained through instruction about or interaction with the environment; Attitudes--dispositions which, together with enabling factors, determine behavior; Enabling factors--variables reflecting aspects of the general situation or personal world view; Behavior--items tapping behavior in the environment. Two different versions of the basic model--one with reciprocal causation among components and one without--were conceptualized to evaluate certain process notions.

Each version was operationalized with 27 variables drawn from a multiphased field experiment. Respondents were 1094 Brazilian farmers who were interviewed on two different occasions. The first survey established antecedent conditions. Immediately following this data collection community newspapers and radio farm forums were established in selected villages. Newspapers and radio broadcasts were produced weekly and contained, among other material, information about 13 different agricultural innovations. Four months after the treatments began a second wave of interviews measured knowledge and attitudes relevant to the 13 practices.

Problems were encountered during analysis. The first-order and multiple-partial correlations used to evaluate the strictly causal version of the model were difficult to interpret because they were statistically significant even when they were conceptually negligible. Specification errors appeared to effect the results of the two-stage least-squares regression analysis used on the reciprocal causation version.

Additional questions of reliability and validity restricted the kinds of subtantive conclusions that could be drawn from the results. Tentatively, however, differences between the two versions indicated that some relationships might be better conceptualized as recursive rather than strictly causative. Both versions revealed that radio forum broadcasts had a slight influence on knowledge acquisition while the effects of community newspapers were negligible.

Several research extensions were suggested and numerous recommendations were made for the future use of causal models in communication research.

MULTIVARIATE CAUSAL MODELS OF INFORMATION FLOW IN RURAL BRAZIL

By

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CHAPTER I

INTRODUCTION

This chapter presents a model of the communication process and proposes to test the implications of the model with data from a field experiment conducted in rural Brazil.

Objectives and Orientation

The year is 1972 and, at last glance, communication research has yet to wither away. On the contrary, it continues to grow and spread with a rough vigor. There are now more learned societies, more researchers, more teachers, and more students devoted to the study of communication than ever before. And their output, despite Mr. Berelson's prophecy, is enormous.

But what of this scholarly output? Every major review during the last five years has reached rather pessimistic conclusions. Researchers appear to be disenchanted with the once promising consistency models and the field is left again without theory. The old generalizations have fallen before contradictory results but nothing has replaced them except "suggested" research. Everyone professes to be systems oriented but continues to examine communication behavior in a piecemeal fashion. Everything has become rather more complex.

This complexity is not altogether unwelcomed. Early communication research was quite restricted to simple minded notions about human behavior. At the same time, however, basic notions of what communication is all about are now lost in a forest of research. Perhaps what the field needs most is a taste of heuristic reductionism.

The objective of this study is to ask some fundamental questions about communication and answer them in an empirically testable manner. To answer the question of how communication occurs, a model has been constructed. It is based on theory and ideas reflected in previous communication research. By reorganizing and relating variables in different ways the model provides a novel and heuristic approach to the study of communication behavior.

Testing the implications of the model is another matter. The model is complex and any thorough test would require much time and funds, neither of which are available. As a compromise, a partial test will be performed on data collected in a previous study. The analysis techniques themselves are somewhat innovative and will enable the evaluation of various process notions that have hitherto gone unexamined.

While not obvious from the stated objectives, the orientation of this study is multivariate rather than univariate. The last ten years of communication research have shown us, if anything, that many variables both influence and are influenced by communication behavior. Systems analysis, for example, is one manifestation of the attempt to account for more complex interrelationships between variables. This study will not attempt a formal systems analysis, for it would require a complete conceptualization and detailed measurement. Since this study is a first attempt at a conceptualization and employs previously gathered data, a formal analysis would be academic. Hopefully, the limited theorization and multivariate analysis herein will be expanded for other problems.

Finally, this study has a practical dimension. The data for testing the hypothetical model were originally gathered during a massive, multiphased communication field experiment in rural Brazil. Throughout this report, an attempt will be made to present results and discuss conclusions in a way useful to those who are primarily interested in the flow of agricultural information in a developing society.

In summary, then, the objectives of this study are to create a model of the communication process and evaluate the model with data on communication in rural Brazil. In the remainder of this chapter the model is spelled out in detail and discussed in terms of prior research. The Brazilian field experiment is described briefly and models appropriate to both the general model and the actual measured variables are introduced.

A General Model

A general, receiver oriented model of the communication process is presented in this section. After introducing the basic components and structure of the model, relevant literature will be systematically reviewed.

Introduction

According to Karl Deutsch (1952) communication models can serve four general purposes:

1. They help organize data and act as a conceptual frame for talking about a system.
2. They generate thinking and hypotheses.
3. They provide as well as lead to predictions about the way the system operates.
4. They can provide precise enough statements about the structure to dictate how states of the system should be measured.

The model presented below serves each of these purposes. Before discussing the relevant literature, however, it will be useful to briefly describe the model in terms of its components and structure.

As Figure 1 shows, the components of the model consist of two different sorts of things. The larger units, labeled ACCESS FACTORS, EXPOSURE, KNOWLEDGE, RECEIVER FACTORS, ATTITUDES and VALUES, ENABLING FACTORS and

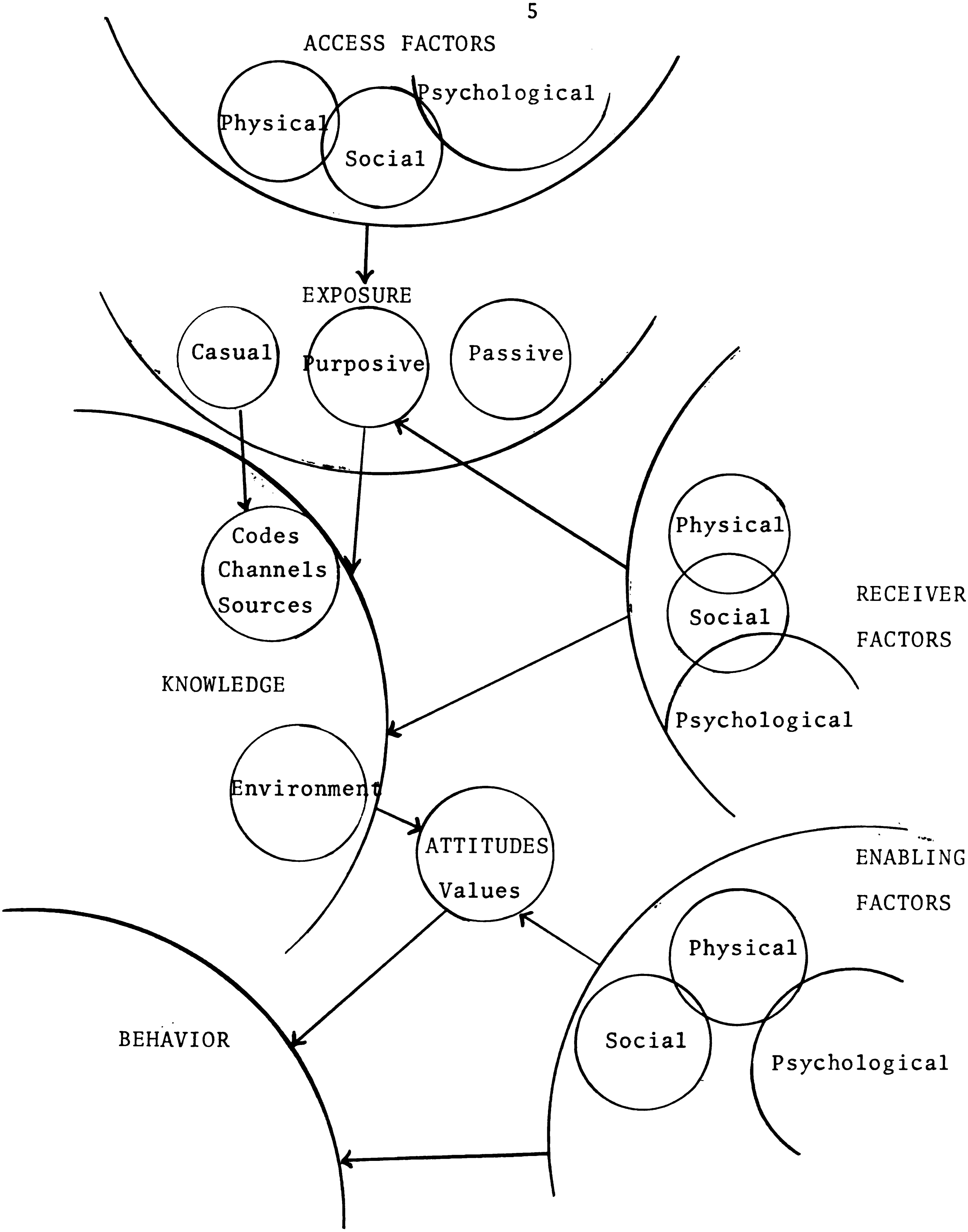


Figure 1. General model--developmental representation.

BEHAVIOR, are general categories. Within these categories are sub-categories of variables. In Figure 1 the general categories are held to be conceptually independent while the sub-categories are overlapping and interrelated.

The structure of the model refers to the relationships between components. Arrows drawn between components in Figure 1 are meant to imply causal connections. Causality here is not used in the strictly logical sense. Rather, components precede, determine, and produce other components. They are at least "necessary" but not necessarily "sufficient" to produce another component. Another way to describe the relationships is to say that arrows between components imply that components are "exogenous." Overlapping sub-categories indicate "endogenous" interrelationships.

The direction of the arrows also indicates that all relationships are non-recursive: influence flows only in one direction. For example, ACCESS and RECEIVER FACTORS are shown to produce EXPOSURE; EXPOSURE does not produce ACCESS or RECEIVER FACTORS. Throughout the remainder of this study, this is an important distinction. Figure 1 is a <u>developmental model</u> that traces a flow of influence through time.

It can also be argued that relationships are really recursive, that it might be more accurate to describe the structure of the model in terms of mutual interrelationships among components. Figure 2 shows a model where all relationships are conceptualized as recursive.

For practical reasons, the following review focuses on the developmental model implied by Figure 1 with only occasional references to the interrelationships implied in Figure 2. When discussing the actual Brazilian experiment, distinctions will be clearly emphasized with two different models. Techniques for testing these two different interpretations will be presented in the methodology section.

Two other features of the models should be emphasized. First, they make no distinction between face-to-face communication and mediated, mass communication. While relationships between components may vary to a degree, they should still exist regardless of mode. In other words, EXPOSURE will intervene between ACCESS and KNOWLEDGE for both face-to-face and mass communication events. Second, the models are completely receiver oriented. There is no independent definition of source, channel or message. These concepts are introduced, but only in terms of receiver perceptions. Admittedly this does violence to the process view of the communication event. On the other hand, as SCHRAMM (1971) recently noted, if we are only interested in the behavior of the receiver, we need only look at his perceptions of the situation. Source intent and definition of messages are only necessary when we wish to talk of relational concepts like education and persuasion.

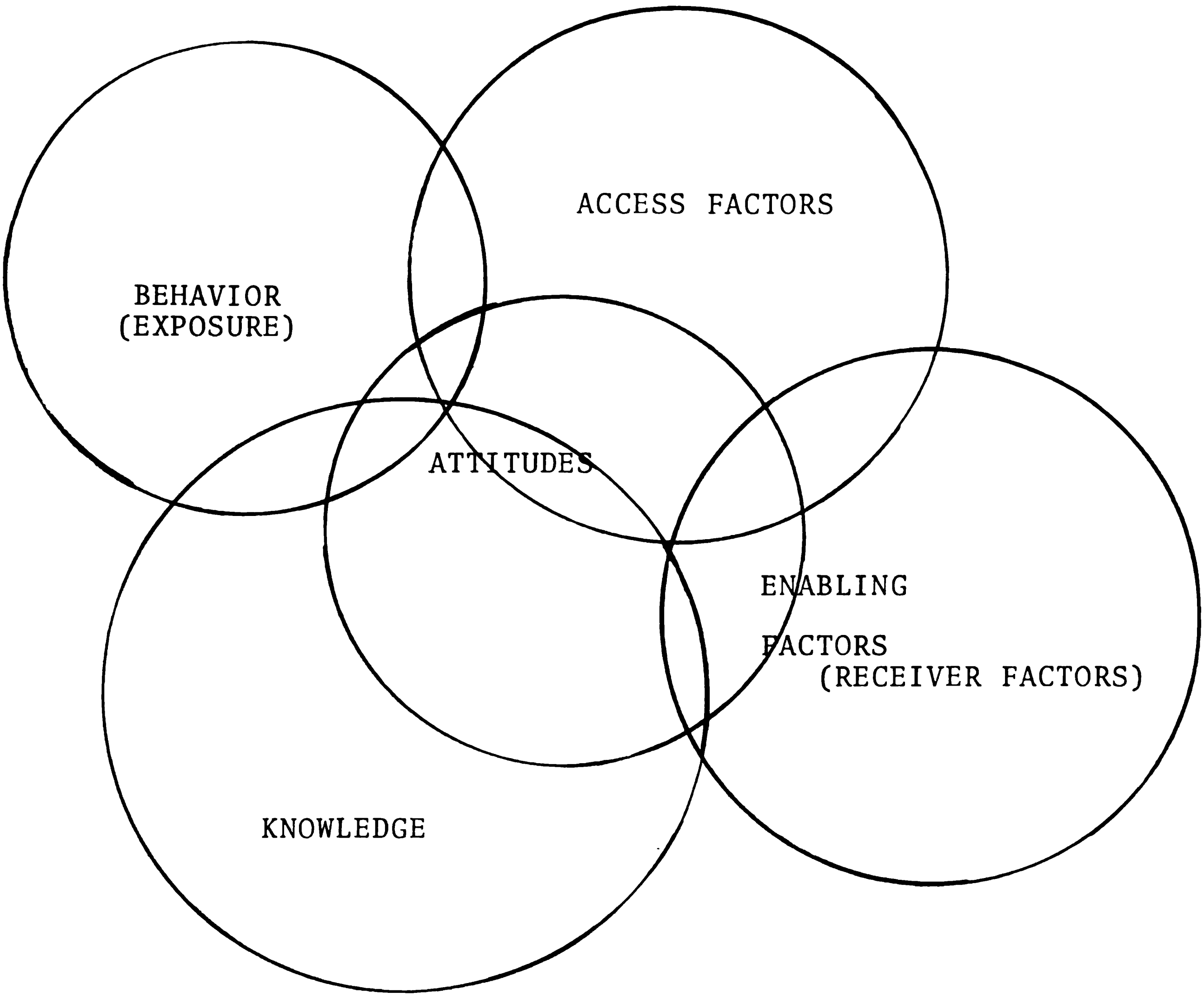


Figure 2. General model--reciprocal causation representation.

The remainder of this section consists of detailed discussion of the components in the developmental model. First, each component is defined and the relevant research is described. Since this is a communication model, most emphasis is placed on those factors which directly influence communication. Thus, prior work on ACCESS, EXPOSURE, and RECEIVER FACTORS will be discussed in detail while only the basic ingredients of KNOWLEDGE, ATTITUDES, BEHAVIOR and ENABLING FACTORS will be covered.

ACCESS FACTORS

Access, very generally, refers to the number of symbolically coded messages in the receiver's environment. Everyone is surrounded by messages. Some originate from sources close to the individual and some from far away. It is important to isolate factors which determine how many messages will be placed within the individual's reach. Three interrelated categories of variables appear to influence access.

Physical variables are material features of the environment. They range from geography and climate to extent of transportation and availability of different power modes. On a theoretical level, only Innis (1950, 1951) provided any detailed discussion of the role of physical variables in the diffusion of messages. Even here, however, physical factors were not felt to be as important as the predominant communication medium in a culture. Innis noted that navigable rivers and the presence of raw materials such as stone, clay, or papyrus could have a major effect on interaction between peoples. On the other hand, he emphasized that the extension of communication networks over larger areas was more dependent on the development of formal code systems and technological advances in dissemination than on raw environmental factors.

A few investigators have introduced physical access variables into their quantitative research. Farace (1965), for example, included climate as one of his variables in factor analytic study of mass communication and national development.

In a different vein, Rogers (1962) reviewed several studies demonstrating the importance of cosmopolite information sources in the diffusion of new ideas and information. Rogers conceptually defined cosmopoliteness as the degree to which an individual's orientation is outside the social system. Since the concept is usually operationalized in terms of trips to urban centers, there is some reason to believe that the development of transportation networks could explain part of the influence usually attributed to "outside orientation."

Social variables encompass basic measures of organization among people. Population density is a basic social variable, while degree of industrialization and type of political system reflect more refined measures. A number of investigators have related these variables to access.

On a theoretical level, Innis (1950) hypothesized that the hegemony one nation or institution could gain over another was due to its superior ability to send and receive messages. He marshalled an impressive amount of evidence showing that changes in social institutions were largely dependent on technological advances in communication media.

Pye (1963) noted that communication roles in traditional societies are not as sharply differentiated as in the more developed countries. This reflects the general principle that more advanced societies require more specialized institutions to maintain and synchronize their activities than do societies with less complicated activities.

The most relevant speculation concerning the relationship of social variables to media access was put forth by Lerner (1958). He hypothesized that modernization could be best understood as a developmental sequence beginning with urbanization. Urbanization was regarded as a necessary condition for mass education. Mass education then created a literate audience for mass communication messages. Exposure to these messages and vicarious role playing developed individual capacities for empathy. Empathic individuals, almost by definition, were more capable of true political participation.

Basic to all of these different theoretical positions is the view that increasing the size of social aggregates increases the number of messages. On one level, larger numbers of people generally result in more interpersonal contacts. On another level, we note the occurrence of institutionalized gatekeepers who gather and disseminate messages.

Empirical research gives a more complicated picture of the role of social access variables in determining exposure. In his study of diffusion of news of the role of the Kennedy assassination, Greenberg (1964) found that access to other persons was a function of both social and physical location. That is, some persons appeared to locate themselves where they could reach others for personal discourse and be reached as well. Schramm and Ruggels (1967) analysed the growth of media systems over a ten year period and tentatively concluded that urbanization might not be as important to the development of literacy as Lerner (1958) maintained.

Psychological variables are those skills which enable an individual to participate in the communication process. At the lowest level, they consist of basic language skills such as knowledge of lexicon and grammer.

At higher levels are literacy and other conceptual skills which allow one to work with abstract symbols.

Theory and research on the effects of the formal structure of speech in communication are generally found under the title of sociolinguistics. Since this study is concerned with larger aspects of communication behavior, this area will not be reviewed here. Interested readers are referred to the excellent review by Ervin-Tripp (1969) and the section on social psycholinguistics in the chapter by Miller and McNeill (1969).

Both Lerner (1958) and McLuhan (1962) developed conceptualizations of the role of psychological variables in providing or allowing access to messages. McLuhan's wide ranging account centers, like Innis' work, on the effects of exposure to a particular medium of communication. Whereas Innis related this exposure to social variables, McLuhan concentrated on psychological phenomena. Generally, McLuhan implied that predominating media affect the sensory balance of those exposed to the media. Sensory balance, in turn, affects all aspects of communication behavior including the ability to process information. This rather unique orientation originally drew much attention but generated little empirical research.

The two communication skills emphasized by Lerner (1958) are literacy and empathy. Literacy was regarded as a necessary skill for those who would expose to the mass media. Empathy was necessary for participation in the political process. Lerner's data appeared to support his hypotheses quite well but more recent research muddles the generality of his results.

The strong position on literacy maintains that literacy indicates far more than just the ability to read. According to Gough (1969), literacy is an "enabling factor" permitting or causing other changes which precipitate modern thought processes. Lerner's (1958) research would tend to support such a position, as would work by Rogers (Rogers, 1965; Rogers and Herzog, 1966).

Other investigators have been unable to support this position. Salcedo (1969) attempted to replicate Lerner's analysis with a causal path analysis of data from three different developing nations. In two cases, the link between literacy and media exposure was quite weak. In the third, literacy and education were too highly intercorrelated to disentangle their effects. Another attempt to replicate Lerner's results was made by McCrone and Cnudde (1967). They found that education rather than literacy intervened between urbanization and mass media exposure. In their opinion, literacy merely indicated that one could read and write while education created a world view that could make mass media content more useful and relevant.

In summary, attention to variables influencing access to messages has been rather cursory. Research shows that such variables are indeed important, but only the speculative theorists have drawn attention to the logically determinate role that ACCESS can play. In the model developed for this study ACCESS serves two different functions. First, it is one source of primarily exogenous variables. ACCESS, while represented by highly interrelated variables whose causal structure remains indeterminate, is antecedent to exposure. Furthermore, the predominant flow of influence should be from ACCESS to EXPOSURE rather than from EXPOSURE to ACCESS. Second, separating ACCESS from EXPOSURE will help clarify the meaning of EXPOSURE; that is, we can now look at differences between people who have the same amount of exposure but varying ease of access to messages.

EXPOSURE

EXPOSURE in this general model is treated as a type of behavior intervening between ACCESS and KNOWLEDGE acquisition. After evaluating prior work on the exposure concept, it seems useful to divide it into the following three components:

1. Passive exposure--time merely spent in the presence of a medium with little attention to content.
2. Casual exposure--time spent with a medium for entertainment or relaxation.

3. Purposive exposure--time spent with a medium to stabilize attributions about the environment.

These distinctions will be spelled out more clearly at a later point. First, however, let us review some of the prior thinking about exposure.

The principle theoretical explanations for exposure apparently originated as a reaction to the hypodermic or "bullet" model of communication effects. Instead of asking what the message did to the receiver, the question became: what does the receiver do with the message? This has come to be known as the functional approach and is cogenty summarized by Fearing (1954): "Those who choose to expose themselves frequently to certain types of communications or to a medium, do so because they seek certain gratifications from the experience or desire to use the medium in personally satisfying ways." (p. 166)

Functional explanations were used by Klapper (1960), and Schramm, Lyle and Parker (1961), to summarize the findings of many different studies of mass communication. In a recent article, Weiss (1969) reviewed these and other positions by noting the four most common gratifications people reported seeking from the media: 1) killing time; 2) relaxation or diversion; 3) for conversations or to enhance prestige; and 4) utilitarian information seeking. While this categorization manages to summarize a number of findings, it has several disadvantages.

Functional interpretations are generally _post hoc_ in nature. They are based, for the most part, on content analytic studies of reasons people give for using (or missing) the media (e.g., Herzog, 1944; Berelson, 1949; Kimball, 1959). Like earlier drive reduction models, they are easily extended to account for new data. To correct for such obvious inadequacies, several investigators attempted to define goals separately from behavior (functionalists tend to infer goals from behavior) and experimentally test their predictions.

Carlson (1960) demonstrated that news interest was a function of three variables; 1) The perceived usefulness of the item in attaining the reader's goals; 2) The importance of the goals; 3) The number and relevance of the message cues to the goal and goal attainment. A similar utilitarian approach was applied by Westly and Barrow (1959).

A refinement of this orientation has been achieved by those analysing the diffusion of new ideas and innovations. Katz (1961) examined decision making concerning both new drugs and agricultural innovations. He found that impersonal sources were sought early in the adoption process while personal sources were sought at a later stage. Mason (1959), reviewing other diffusion literature, drew different conclusions. He felt that information seeking was more dependent on the importance of the decision, the alternatives involved, the degree of support or sanctions present and the availability of information. Regardless of their difference, however, both Katz and Mason agreed on the importance of situational factors for information seeking and exposure.

In addition to those who investigated utilitarian information seeking, others have concentrated on exposure for individual pleasure, escape, or entertainment. Rather than extend the utilitarian principle, they postulate that certain personality variables will predict exposure to certain content. Klapper (1960) devoted a whole chapter to the effects of escapist media. He cautioned against evaluating the effects of media by their content alone. More recently, Katz and Foulkes (1962) and McLeod et al. (1965) analysed in detail the non-informational aspects of exposure.

Unfortunately, a relatively careful review of the exposure literature failed to reveal the relevance of the above mentioned explanation for observed patterns of exposure. The two major patterns--selective exposure and the "all or nothing" hypothesis--are either based entirely on empirical observations or have theoretical underpinnings from another field.

As part of his review of the attitude literature, McGuire (1969) separated the selective exposure hypothesis into two different statements. The first statement proposed that people actively expose to information consistent with their beliefs. This hypothesis has been supported by a suitably impressive number of studies. The second hypothesis holds that people actively avoid exposing to information counter to their beliefs. In McGuire's opinion, the support for this statement is questionable. Both hypotheses were explained in terms of dissonance theory or other consistency orientations.

The "all or nothing" generalization was first proposed by Lazarsfeld and Kendall (1963) to describe certain regularities found in mass media exposure patterns. In general, it appeared that if a person attended a great deal to one medium, he also attended heavily to other mass media. The generalization received immediate support from a study of voting and communication (Berelson, Lazarsfeld and McPhee, 1954). Further support came more recently from research conducted in the developing nations (Carter and Sepulveda, 1964; Deutschmann and Danielson, 1960; Deutschmann, 1963; Rogers, 1965).

Contrary evidence was presented by Greenberg and Kumata (1968) in their study of exposure among respondents in a U.S. probability sample. Failure to replicate was also reported by McLeod, Rush and Friederich (1968) for their examination of media use by residents of Quito, Ecuador.

Research on the effects of exposure shows some of the same contradictions as studies of patterns. In terms of attitudes, McGuire (1969) pessimistically concluded from his review of the literature that exposure to mass communication has almost no effect on attitudes or opinions. What change does occur can be generally traced to interpersonal communication or extenuating circumstances.

Research findings on exposure and knowledge reveal more positive results. Although there are some outstanding examples of miscomprehension and miseducation (cf. Lazarzfeld, 1948; Cooper and Dinnerman, 1951) people do appear to learn from the mass media. Studies of exposure and knowledge of innovations in the underdeveloped countries show high correlations despite the fact that most mass media content is distinctly inappropriate for those who need the agricultural innovations. (Rogers with Svenning, 1968; Durlak, 1969). Similarly, exposure and political knowledge are generally correlated in the developing nations (McNelly and Deutschmann, 1963; McLeod, Rush and Friederich, 1968).

What can we conclude from all this talk about exposure? First, there is a depressing lack of coordination between reasons for exposure, exposure patterns, and exposure effects. The study of each phenomenon appears to have been initiated independently of the other. Second, contradictory results are difficult to evaluate.

Inconsistent support for the "all or nothing" hypothesis could result from different measures of exposure used by the independent investigators. Or, they could result from the fact that different types of media were studied by each researcher. Finally, content of messages and situational context differed for each study. Thus, we cannot determine the real locus of disagreement. Third, no attention has been paid to the preconditions necessary for exposure. It is obvious that some people must expend more effort to expose than others. Their willingness, or ability to expend such effort will undoubtedly be correlated with the process and effects of exposure. Such reasoning might help clarify the apparent contradictions between studies conducted in the U.S. and in the developing countries. Clearly, the concept of exposure needs reformulation.

The general model presented here attempts to resolve such problems by redefining exposure into three components and adopting a multivariate approach. Exposure is said to result from interaction of ACCESS and RECEIVER FACTORS. Effects, in turn, are due to RECEIVER FACTORS and EXPOSURE. Patterns of exposure differ within each type of exposure. Needless to say, the whole picture is a bit complicated.

As mentioned previously, passive exposure is exposure in name alone. This is time merely spent in the presence of a medium. The housewife who vacuums with the TV turned on and the teenager who studies while "listening" to the radio are both theoretically exposed; however, they pay little attention to content and the content is of little importance to them. ACCESS has a major effect on passive exposure. If the medium were not readily available, receivers would not expend a great deal of effort to find another. Furthermore, should circumstances change, another medium would readily substitute. This might explain the decline of newspaper circulation in the 1950's. If newspapers were used for killing time while riding public transportation, then they should have been readily replaced by radio as men began driving their own cars to work. Similarly, the "inertia effect" coined by Parker (1961) to account for increased viewing of a channel after popular TV programs probably reflects a great deal of passive exposure.

Unfortunately, the passive exposure category presents certain measurement problems. Since little or no attention is involved, passive exposure is irrelevant to knowledge gain or other potential effects. As such, it would be difficult to separate from error variance.

Casual exposure is only casual in the sense that it reflects a certain purposelessness. It consists of all exposure indulged in for its own sake as opposed to exposure necessary to satisfy goals or environmental demands. Exposure for entertainment and relaxation is included in this category.

Content is attended to in casual exposure but it is not important for daily living. People will go to some effort to entertain themselves but will readily change to other media offering easier access. The decline in newspaper circulation due to the spread of radio and the decline of movie attendance due to television both reflect changes in casual exposure. In the case of movies, attendance is now concentrated among the highly mobile (young people) and among those for whom movie attendance creates prestige (those with higher education or S.E.S.).

In the general model, casual exposure is hypothesized to have an effect on attributions about channels, codes and sources but not on the more general attributions about the environment. This is, more or less, a distinction by default. While it is reasonable to predict that positive experiences with the content of a medium will lead to a general liking of the medium, we know too little about the actual process of entertainment or "play" to predict more complicated effects. Berlyne's (1969) explanation of humor, laughter and play is probably our best analysis of what happens during casual exposure, but he fails to discuss social or cognitive dimensions. Furthermore, most of our cognitive theories will not explain such non-goal directed behavior. For the time being, then, casual exposure must remain somewhat underexplicated.

In contrast to casual or passive exposure, purposive exposure is directed and deliberate. Whereas casual and passive exposure are primarily determined by physical access to message sources, purposive exposure depends on literacy and other communication skills. We will assume that purposive exposure is initiated because the individual is uncertain about aspects of the environment. To stabilize attributions or cognitions information is sought. Given access, search will result in exposure and attributions will be changed. Purposive exposure will affect both attributions about codes, sources and channels _and_ general attributions about the environment.

Now we can talk about why this conceptualization is better than previous viewpoints. First, it is important to note certain similarities. The three components account for Weiss' four categories. When people use the media for killing time or for relaxation, their exposure is either passive or casual. When they expose for social or personal reasons, their exposure should be called purposive.

This conceptualization also incorporates Schramm's (1949) distinction between "hard" and "soft" news. Schramm postulated that soft news was sought for immediate rewards while hard news was used primarily for delayed rewards. The passive, casual, purposive distinction makes no a priori content classifications but does distinguish between immediate and delayed rewards. Most casual and passive exposure will be immediately rewarding, while purposive exposure leads to a more complicated process whose reward is not immediately apparent.

The "all or nothing" hypothesis should hold for purposive exposure but not for casual or passive exposure. Support for the "all or nothing" generalization came from research done in the United States in the 1940's and from the developing nations in the 1950's and 1960's. Contradictory evidence came from one U.S. study done in the late 1960's and one developing nation study of urban residents also done in the late 1960's. It is quite possible that limited access in the earlier studies accounts for the supportive information.

The reasoning is as follows: when media sources are less available, receivers will confine casual or passive attendance to readily available sources. On the other hand, those with specific information needs will be more willing to go to the effort of exposing to less available sources. Since media were much less available in the 1940's and in the developing countries, heavy exposure patterns were likely to reflect highly purposeful use. In the later studies, diffusion of radio and television receivers made media much more available for entertainment purposes. Thus, any exposure patterns would have been washed out (correlations attenuated) by the greater amount of passive and casual use.

Unfortunately, this is a difficult hypothesis to evaluate. In the first place, access to specific contact--the object of purposive exposure--would have to be equally available on all channels. One could test with information about election campaigns or hograising but not with messages about coin collecting or German history. Secondly, available leisure time might also explain some of the contradictions between studies (cf. Samuelson, Carter and Ruggels, 1963). In both cases, appropriate controls would have to be introduced. Many of these controls are included in the component called RECEIVER FACTORS.

RECEIVER FACTORS

RECEIVER FACTORS directly influence individual information seeking and utilization. The distinction between RECEIVER FACTORS and ENABLING FACTORS rests on the notion of direct versus indirect influences. Ownership of a radio is highly correlated with frequency of listening. So is income. Radio ownership is a RECEIVER FACTOR because it is directly related to listenership. Disposable income determines radio ownership but its effect on exposure can only be indirect. In a model where all variables are interrelated (or endogenous)

RECEIVER FACTORS would be part of the more general ENABLING FACTORS. For the developmental model, however, they are separated. RECEIVER FACTORS are also divided into three interrelated categories.

Physical variables are aspects of the receiver's environment relating directly to his ability to send or receive messages. Ownership of broadcast receivers and newspaper subscriptions fall into this category. On an interpersonal level, the ownership of a means of transportation or telephone are also included.

The importance of such variables has been generally overlooked in previous studies. In some cases, ownership of media has even been used in composite exposure indices. The fact is that such variables play a very important, if yet indeterminate, role in communication behavior. Deutschmann and Danielson (1960) found that sheer ownership of radio or television receivers, along with education, were best predictors of first knowledge of a news event and discussion with others. McLeod, Rush and Friederich (1968) determined that radio ownership was a better predictor of political knowledge than was simple frequency of listening. This was true even after controlling for the effect of income. Because of a high correlation between readership of hard news and media ownership, these results suggested that having your own media may depend on more factors than disposable income alone.

Social variables operate through the locus of the receiver's primary groups and affect both perceived utility of information and exposure habits. Variables in this category include group exposure habits as well as social utility aspects of opinion leadership.

The covariate effects of group participation and radio listening have been extensively analysed. In the early 40's, Lazarsfeld and others (Lazarsfeld, 1942; Lazarsfeld and Field, 1946; McCandless, 1944; Robinson, 1941) demonstrated that exposure to radio had more effect on knowledge and behavior change when it was linked to preexisting personal relations.

More recently, studies in the developing countries have shown a strong relationship between group listening and desired effects (Louis and Rovan, 1955; Mathur and Neurath, 1959; Mathur and Saksena, 1963; UNESCO, 1960, 1965). Apparently, group discussion not only reinforces the learning of content and acceptance of innovations but it also teaches receivers to use the media as a source of information rather than simply as a source of entertainment.

The social utility of interpersonal communication can be taken almost as a given: communication is at least a necessary condition for the concept "social."

Theory and research on the social utility of mass communication has generally dealt with less obvious effects. On one level, Wright (1959) specified three kinds of social utility the mass media serve:

1. Surveillance--The media act as watchdogs for danger occurring in the environment.

2. Coordination--The media coordinate responses to the environment.

3. Transmission of the social heritage--Media make norms public and note when sanctions are applied against those who violate them.

All of these functions reflect the social maintenance role played by the mass media.

On a less grand level, Merton (1949) was one of the first to recognize that media use was also a function of the social roles of individuals. He pointed out that opinion leaders who were locally oriented used different media and had different interpersonal communication patterns than those who were oriented outside the local social system.

Most studies of the two-step flow of communication found that opinion leaders were more exposed to the mass media than their followers. Aside from a few early studies indicating that leaders had an interest in particular topics, no one has attempted to find out if opinion leaders derive any particular gratifications from their positions. While it is highly possible that some people find themselves leaders because of circumstances, others may actively pursue such a position because of the social prestige and power it affords.

Summarizing research on the opinion leader concept, Weiss (1969) pointed out the value of making a distinction between active and passive leaders. Active leaders, it seems, directly seek out those they wish to influence. Passive leaders, on the other hand, respond to requests for information. It is possible that passive leaders seek information to cope with their own situations. They are sought out because of their known competence. Active leaders might instead seek information because of its social utility. They trade information for other favors--including the prestige it gives them.

Psychological variables are personality measures indicating variations in the ability or propensity to seek and process information. A number of such variables are found in the literature. Although cognitive style measures and characteristic ways of responding to sources could be included in this category, our major concentration will be on cognitive development variables.

While general intelligence and abstract reasoning ability are both specific measures of cognitive development, we are forced to settle for the more general "education" variable. Education is more easily measured in a field survey and also relates more directly to our other components. It will also be interesting to separate education from literacy and see if they do indeed play a different role in communication.

Education, as mentioned previously, implies more than literacy. After a person has gone to school for a number of years, he acquires a number of complex skills. He learns not only how to read, but also how to purposefully seek out information. He learns abstract principles that help him to store information efficiently. He learns how to learn.

Of course, there is a great deal of error variance in the "education" variable. Not everyone learns how to seek information or use available sources. Certainly not everyone learns how to learn. At the same time, attributing the effect of education to literacy alone is also a mistake. Many people in underdeveloped countries learn to read from friends or family. Out of the context of the classroom, they may have learned an entirely different content. Perhaps the best solution is to include both variables. In this study literacy will be treated as an ACCESS FACTOR, while education--implying more complex skills--is a RECEIVER FACTOR.

KNOWLEDGE

KNOWLEDGE, in our model, is used in its most general sense: information, attributions, and beliefs could substitute equally well. The only thing we assume is that knowledge is acquired through instruction or direct interaction with the environment. As the model shows, EXPOSURE and RECEIVER FACTORS act to constrain or enhance this process. We will separate attributions about the environment from attributions about channels, codes and sources for practical reasons. The theory and research on knowledge acquisition is immense and cannot be dealt with here. Work on source attributions is not so extensive and also more germane in terms of the available variables.

A substantial body of research indicates major differences in reactions to personal versus mass media sources. Klapper (1960) concluded, in general, that personal, face-to-face persuasion was superior to mediated persuasion. Furthermore, personal face-to-face lectures seemed to result in more learning of simpler material than did mediated lectures. This second point was complicated by other findings and, as a result, remains rather tentative. Reports on public attitudes toward the media are consistent with these basic findings.

Several studies have compared personal sources with mass media sources. Ramos (1966) asked a sample of farmers from three Columbian villages to choose the most credible medium among all possible paired combinations of six sources. Extension agents were most credible, followed by school teachers, radio, neighbor, salesman and newspaper. Using a different technique, White (1967) showed that a sample of Canadian farmers regarded personal sources as much more important than the mass media when it came to information about a variety of specific agricultural innovations. Sargent (1965) compared mass media sources "in general" with specific mass media commentators. The personal sources rated more accurate, sincere, responsible and impartial than non-personal sources.

The origins of media evaluations are difficult to trace. Certainly, as Schramm, Lyle and Parker (1961) have suggested, preferences are partially due to early childhood experiences with both content and format. Unfortunately, the absence of good longitudinal data does not allow us to examine such experience with much precision. Other studies have linked credibility judgments to demographic indices. Westley and Severin (1964) found that more men than women trusted newspapers over television and more urban residents than rural residents believed newspapers to be more credible. In a later study, Greenberg (1966) showed that older, better educated men tended to place their trust in newspapers while younger, less educated women chose television.

Characteristics of the media and prior exposure habits are also related to credibility judgments. All studies of public attitudes toward the media reveal a strong correlation between the medium used most for news and the medium most trusted (Westley and Severin, 1964; Carter and Greenberg, 1965, 1966; Carter and Sepulveda, 1964; Simons, Kent and Mishra, 1968). Carter and Greenberg gained further insights by asking people why they chose one medium over another when accounts disagreed. Television was chosen because of better personnel, because of the pictorial dimension and because "other media were biased." Newspapers were chosen because people preferred print or always used newspapers and because newspapers were more complete.

While there is a substantial body of research on media credibility, there is little explanation of how and why such expectations accrue. Indeed, we are not even very sure about what is being measured, since no studies have attempted to systematically relate credibility judgments to other media behavior. Most investigators simply asked respondents which medium they would believe in the case of conflicting reports; some asked which medium was most trustworthy. These judgments are usually labeled attitudes for convenience sake but appear to go beyond the usual conceptualization of attitude. That is, they seem to reflect an expectation. When persons trust a source, they usually expect that source to behave in a particular way. Thus, judgments of source credibility could be confounded by a sizable knowledge component.

In this model, evaluations of source credibility have been placed in the KNOWLEDGE component. This is not entirely adequate but is a relatively functional solution given the available data. A detailed theoretical rationale for such a position is unnecessary at this point but is available for the interested reader (Kochevar, 1971). Otherwise, our particular analysis techniques will allow us to evaluate the structural utility of our decision.

ATTITUDES

Now that our homunculus is full of knowledge, how do we get him to behave? In previous years, psychologists postulated attitudes as the crucial intervening variable between knowledge and behavior. Knowledge was supposed to have cue properties and attitudes were thought to have both cue and drive producing aspects. This distinction, unfortunately, proved to be quite unwieldy: semantically, at least, *any* stimuli can have both cue and drive producing qualities. Empirical attempts to relate attitudes and information have proved to be equally frustrating (Dervin, 1967; McGuire, 1969).

No attempt is made in this study to reduce the complexity of the attitude theory morass. Our model shows that ATTITUDES are produced by KNOWLEDGE and ENABLING FACTORS. In combination with ENABLING FACTORS, ATTITUDES are shown to cause BEHAVIOR. For future research, this part of the model could be further specified by the addition of the value construct. Values could be defined as desired states the individual wishes to obtain and, when combined with knowledge, would lead to specific attitudes.

Values in this case would be a useful bridge between the more general ENABLING factors and the more specific attitudes. This is similar to the meanings put forth by both Rokeach (1968) and Waisanen (1968). A heuristic explication of the knowledge-attitude-value combination can also be found in Jones and Gerard (1967). While parsimony would be ill-served by such a construction, the replacement of one concept with three might allow us to predict obviously complicated behavior with greater precision.

ENABLING FACTORS and BEHAVIOR

ENABLING FACTORS are similar to what other writers have called the situation or the situational threshold (Rokeach, 1967; Campbell, 1963). They arise out of an individual's physical, social and psychological environment and serve to constrain or enable behavior in that environment. Unlike RECEIVER FACTORS, ENABLING FACTORS are not directly related to communication behavior. ENABLING FACTORS are conceived on a much grander scale and have been traditionally the main concern of political scientists, economists, and sociologists.

Like RECEIVER FACTORS, ENABLING factors can be divided into three interrelated components. Because they only effect communication behavior indirectly, however, they will not be elaborated in terms of prior research.

Physical variables consist mainly of political and economic variables. Politically, behavior can be constrained or aided by the police and the army. Although we usually consider such effects only in extreme circumstances, other political variables can have an enormous effect on a wide variety of economic behaviors. Economic factors are more closely related to behavior. Other things being equal, for example, the availability of capital, usable land, and outside labor will enable a farmer with positive attitudes toward an innovation to adopt that innovation.

Social variables consist of group norms and orientation within a social system. Group norms can act to enable or inhibit behavior. Their effect can either be direct or indirect. Physical sanctions or rewards influence behavior directly. Indirectly, the awareness of group norms can reduce or increase the stability of one's attributions about an action sequence.

Orientation within the social system covaries with response to group norms. If a person is oriented outside of his social system, social influence will have little effect on his behavior. For those with a stake in the system, the opposite is true. The role of communication in social influence has been studied both experimentally (cf. Collins and Raven, 1969) and with survey techniques (Durlak, 1969).

Some of the effect of group listening on adoption behavior could well be due to the discussion of ENABLING factors among participants. After they discuss the content of a program, they probably voice opinions about the meaning of such content for their social system. Norms become clear and plans for group action can be developed.

Psychological factors are composed of variables signifying a characteristic and general world view. Achievement motivation (McClelland, 1961) is one kind of enabling factor. Self-esteem (Rosenberg, 1965) is another. Fatalism, dependency, and attitude toward level of living are more global measures within this factor (Rogers with Svenning, 1968).

Summary

The general developmental model presented in these pages was designed to accomplish four purposes. How successful was it?

First, it helped organize a large amount of previously unrelated data. It reflected a number of theoretical notions and also served as a conceptual frame for communication behavior in a complex environment.

Second, it helped generate thinking and hypotheses. The frankly over-abundant number of speculative statements is admittedly unwieldy. However, their potential for future payoff appears promising.

Third, the general model leads to a number of predictions about the way the system operates. So many predictions are made, in fact, that special multivariate techniques will be necessary to test them all.

Fourth, the model was supposed to be precise enough to dictate how states of the system should be measured. This has not been a major feature of our discussion. While numerous variables were mentioned, very few operational definitions were presented. There are two reasons for this omission. In many cases, variables were drawn from prior research. These previous operationalizations should be adequate for initial tests of the model. Secondly, the variables used in this study were drawn from research designed for other purposes. To suggest how variables should be measured and then describe how they were actually measured is an exercise that is best confined to the Discussion section.

In summary, then, the general model is relatively successful for what it was supposed to do. Now it is time to check it against reality.

Agricultural Information in Rural Brazil

Implications of the general model can be tested with data gathered in a multiphased Brazilian field experiment. In this section the highlights of the experiment are described briefly and two different models are presented. One model assumes non-recursive relationships and can be appropriately analysed with a multiple indicator path analysis. The second assumes fewer non-recursive relationships and calls for a two-stage least-squares regression analysis.

Background

Logically speaking it is impossible to establish the direction of causal relationships with correlational evidence. We can have more confidence in causal inferences, however, if we can demonstrate that, in addition to being correlated, one variable also precedes another variable in time. A field experimental design generally fulfills this criterion by evaluating crucial variables both before and after the introduction of experimental treatments. The data used in this study resulted from such a design.

The field experiment reported here was part of a large study of communication and adoption of agricultural innovations conducted in the state of Minas Gerais, Brazil, from June, 1966 to January, 1968 (Stanfield *et al.*, 1968).

Overall, there were three separate phases. In Phase I, the effectiveness of the Agency for Credit and Rural Assistance (ACAR) in Minas Gerais was assessed with a field survey of land owning farmers. The major purpose of Phase II was to specify the antecedent conditions before the introduction of experimental treatments. After Phase II data collection, community newspapers and radio farm forums were introduced in selected communities. When the communication treatments had operated for four months, an attempt was made to reinterview all the respondents in Phase II. The final sample on which this report is based consisted of 1,094 respondents who were interviewed in both Phase II and Phase III.

Data on ACCESS, EXPOSURE, RECEIVER FACTORS and media attributions were collected in Phase II. The weekly newspapers and radio broadcasts contained information about 13 different innovative practices. Knowledge and attitudes toward these practices were measured in Phase III. Thus, we have some control over the time order suggested by our hypothetical development model.

The field experiment was quite complicated. The design itself had several different levels and was arranged to test many hypotheses. In addition, there were a variety of unforeseen events and complications. These factors are described in detail in the design chapter.

Variables

An enormous amount of information was collected in the Brazil study. Interviews ranged in length from 45 to 90 minutes and the coded information filled almost 16 IBM cards for each respondent. Much of this information dealt with specific farm practices and is of no concern here. Some of the data has been analysed previously with rather unsuccessful results. Empathy and generalized trust, for example, were unreliable and operated in unexpected ways. These variables will also be excluded from our analysis.

An ideal test of the model would require several variables in each component. Unfortunately, we lack all the necessary ingredients for a complete test. In some cases we have many items and in others we have too few. Fortunately, we can cope with these problems in several ways. First of all, our analytic techniques allow us to work with many variables. Instead of collapsing items into an index which obscures individual variance, for example, the multiple indicator model will allow all items in a factor to be compared systematically. Secondly, the logic of our analytic techniques enables us to determine the best fit for our data. If, for example, cosmopoliteness is found to be directly related to KNOWLEDGE, instead of indirectly related as the model implies, then we can fruitfully modify the model. The numerous questions raised by such a procedure will be considered in the Chapter on Methodology.

Finally, the nature of the variables might even prove advantageous. In the U.S., a media rich country, the range of ACCESS, EXPOSURE, and RECEIVER FACTORS tends to be restricted. For this reason, correlational tests will yield attenuated results. With the Brazil data, this is not the case; most variables have wide ranges and high variance.

Therefore, despite the obvious shortcomings of the data, they do enable a partial test of the general model. The nature of the tests will become clearer as we conceptually define the variables and describe their interrelationships.

Reasons for Two Models

Throughout this chapter, mention has been made of two models: a developmental model and a reciprocal causation model. The developmental model derives directly from theory and prior research while the other is more apt to reflect the reality with which we are forced to deal. Under ideal conditions, we should be able to trace a child's development along the lines indicated in our developmental model. Trying to infer this pattern thirty years later requires a few assumptions.

In our developmental model, for example, we show that KNOWLEDGE leads to ATTITUDES. This is not unreasonable. Yet, we are working with data in which many changes could have occurred. Perhaps positive attitudes toward an innovation led to further exposure and, hence, more knowledge. In this scheme attitudes would lead to knowledge. Similarly, we have social influence, a RECEIVER FACTOR, causing exposure and retention of information. Here we hypothesized that people seek knowledge for the power and prestige it gives them. On the other hand, the farmers were asked to nominate people they thought were knowledgeable. Which is first? Is influence caused by knowledge or does the desire to influence lead to knowledge?

There is no exact answer to this type of question. There are, however, many approximations. The developmental model is one such approximation. Like a law in physical science, it represents an ideal. We make a large number of assumptions and see how well actual data fit the model. If the fit is close, we can have relatively greater confidence in our hypotheses. If the fit is not so good, we must question our hypotheses and assumptions.

In the reciprocal causation model, we make fewer assumptions. Thus, by comparing our results from the two models, we can evaluate our assumptions to an extent not possible using either model alone. The procedure is somewhat similar to what a scientist does when he tests a law or model under different environmental conditions.

Examination of the schematic representations of each model will highlight their obvious differences. In each case, rough conceptual definitions are provided for the variables--exact operational definitions can be found in the Design Chapter. After each model, there is a short paragraph on the mathematical techniques that will be used for their evaluation.

Blocked Indicator Model

The developmental model is represented in both Figures 3 and 4. This arrangement does not indicate any particular conceptual difference: it was impossible to follow all the criss-crossed lines when they were drawn on one sheet. The variables are as follows:

ACCESS FACTORS

a_1 - Cosmopoliteness - The availability of transportation networks

a_2 - Social Participation - The availability of social networks

a_3 - Literacy - The ability to read printed material

a_4 - Newspaper Community - Community newspaper available

a_5 - Radio Forum Community - Radio forums available

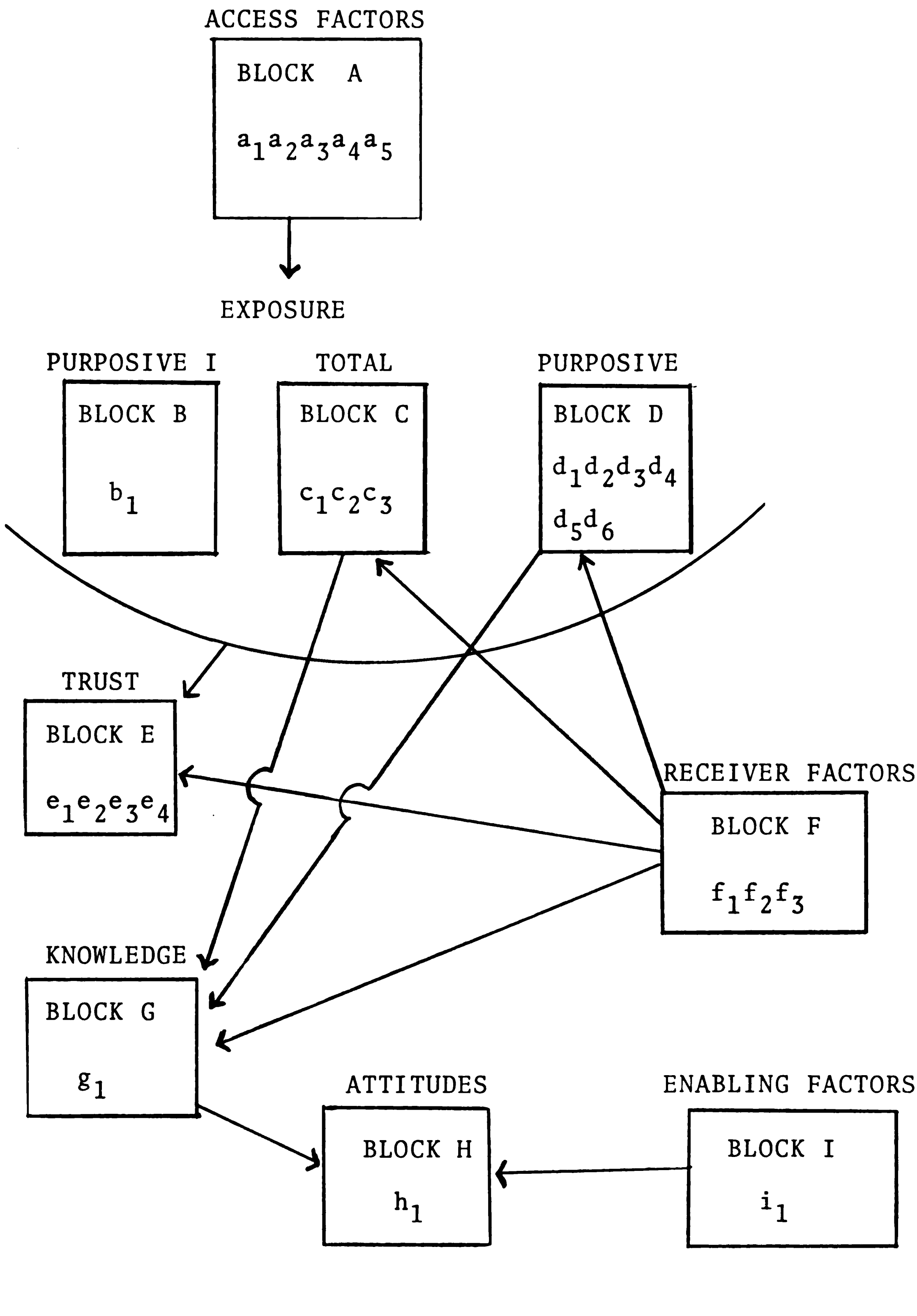


Figure 3. Blocked multiple indicator model.

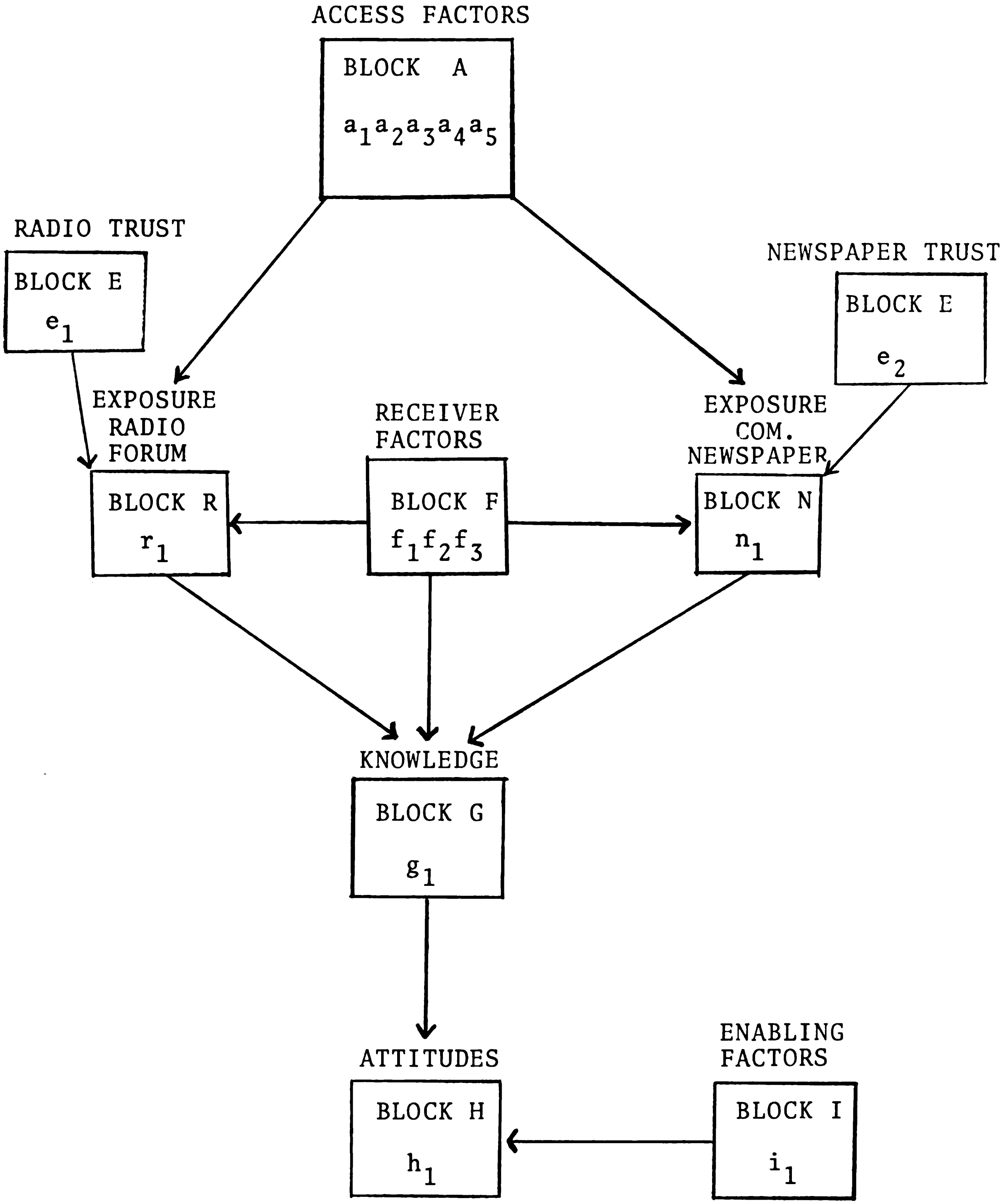


Figure 4. Blocked indicator model: effects of experimental treatments.

EXPOSURE

b_1 - Purposive Radio Exposure I - Preference for agricultural or news broadcasts over music or sports programs

c_1 - Total Print Exposure - Number of newspapers and magazines read monthly

c_2 - Total Radio Exposure - Frequency of radio listening

c_3 - Total Exposure to ACAR - Frequency of actual contacts with change agent

d_1 - Purposive Newspaper Exposure - Newspaper is usual source of agricultural news

d_2 - Purposive Magazine Exposure - Magazine is a usual source of agricultural news

d_3 - Purposive Bulletin Exposure - ACAR Bulletins a usual source of agricultural news

d_4 - Purposive Radio Exposure II - Radio a usual source of agricultural news

d_5 - Purposive Agent Exposure - Agent a usual source of agricultural news

d_6 - Purposive Neighbor Exposure - Neighbor a usual source of agricultural news

TRUST

e_1 - Trust in Radio - Radio credibility

e_2 - Trust in Newspaper - Newspaper credibility

e_3 - Trust in ACAR Agent - ACAR credibility

e_4 - Trust in Neighbor - Neighbor credibility

RECEIVER FACTORS

f_1 - Radio Ownership - Presence of radio in home

f_2 - Education - Years of formal education

f_3 - Social influence - Number of nominations as person having agricultural influence in community

KNOWLEDGE

g_1 - Knowledge of Innovation - Summated index of knowledge about 13 innovations

ATTITUDES

h_1 - Attitudes Toward Innovations - Summated index of attitudes toward 13 innovations

ENABLING FACTORS

l_1 - Income - Total yearly income

EXPOSURE TO RADIO FORUM

r_1 - Exposure to Forum Broadcasts - Exposed once or more to forum broadcasts

EXPOSURE TO COMMUNITY NEWSPAPER

n_1 - Exposure to Community Newspaper - Exposed to one or more issues of community paper

Before elaborating on the model, it is necessary to say a few words about some of the variables. There are many exposure variables, none of which are particularly close to our conceptualization. In our scheme of things, "total exposure" to any medium represents casual, passive, and purposive exposure all added together. Having a usual source of agricultural news approaches what is meant by purposive exposure. Similarly, although we must be cautious about making inference from content preferences, we will assume that a preference for news and agricultural information represents purposive exposure while a preference for music or sports represents more casual exposure.

The KNOWLEDGE FACTORS from our general model are also imperfectly matched. Knowledge of innovations is an adequate measure of attributions about the environment but the trust variables present a problem. Original, low level questions intended to tap knowledge of the media proved to be useless; the vast majority (96%) of respondents, for example, knew they could receive agricultural information from radio or newspaper. Hence, we are forced to rely on trust variables reflecting a rather ambiguous expectation and potentially confounded with personal values or attitudes.

BEHAVIOR, ATTITUDE and ENABLING FACTORS are represented somewhat scantily. The appropriate measure of behavior should have consisted of actual data on the adoption of the 13 innovations. Unfortunately, no such measures are available. So little time elapsed after the end of communication treatments that the organizers of the Brazilian field experiment felt they could not measure adoption adequately. The attitude index is appropriate enough but relevant values were not evaluated and we are thus unable to examine any propositions concerning attributions, values and attitudes. Income is the only surviving enabling factor. Other factors like achievement motivation seem to have been modified since they were gathered and cannot be uniquely identified.

The relationships implied in Figures 3 and 4 are relatively straightforward. ACCESS FACTORS are predicted to have a direct effect on EXPOSURE but an indirect effect on trust, knowledge and attitudes. Any EXPOSURE will lead directly to trust but only purposive and total exposure will lead to KNOWLEDGE. KNOWLEDGE intervenes between EXPOSURE and ATTITUDES. RECEIVER FACTORS will produce purposive and total exposure, as well as trust and knowledge. In Figure 4, arrows are drawn from trust to experimental exposure. Thus, we will test to see if trust, like attitudes, also produces a predisposition to respond.

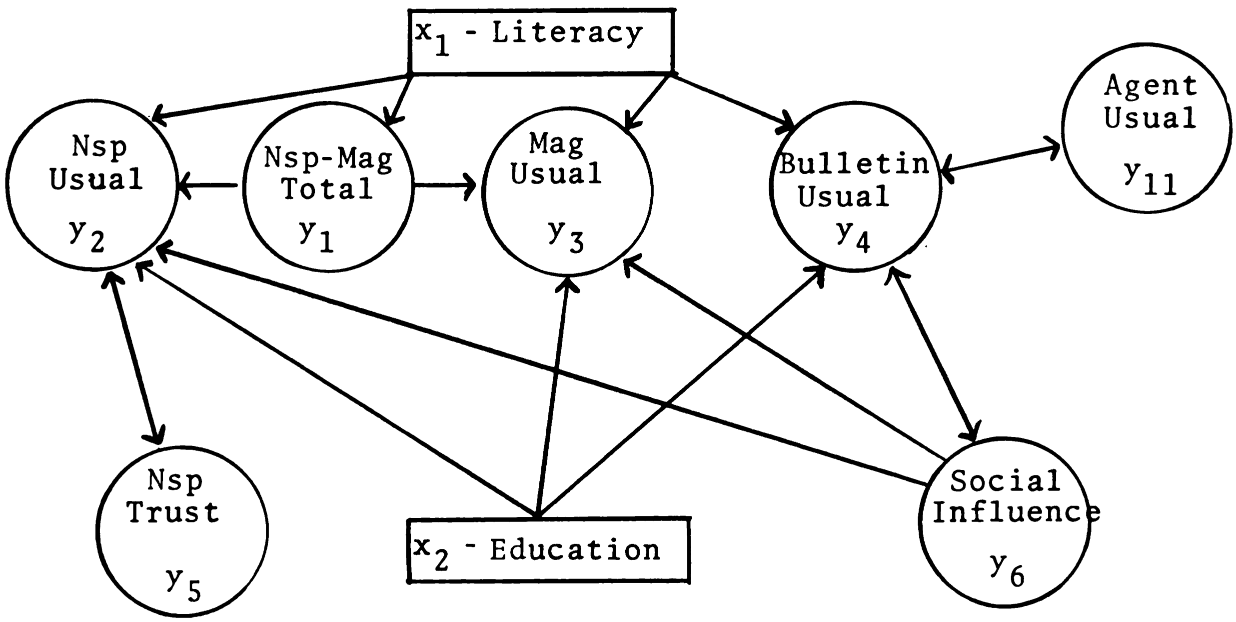
KNOWLEDGE, ATTITUDES, and EXPOSURE to experimental treatments were all measured during Phase III, while all the remaining variables were tapped a year or so earlier in the Phase II data collection. Therefore, we have somewhat greater confidence that ACCESS, EXPOSURE and RECEIVER FACTORS preceded KNOWLEDGE, ATTITUDES and experimental exposure in time order.

A conventional Simon-Blalock path analysis with blocked indicators will be used to test the developmental model. Blocked indicators offer a unique advantage. Ordinarily, the combination of items into an index for each component of the model would tend to obscure important variance--expecially when the individual variables are so disparate. The solution is to leave them separate and work with multiple-partial correlation coefficients instead of regular partials. Multiple-partials are calculated for both assumed and predicted relationships and tested for significance. A detailed discussion of this procedure is included in Chapter 2.

Reciprocal Causation Model

Although it uses the same variables, the reciprocal causation model is much more detailed than the developmental model. Glancing at Figure 5, we observe obvious differences in the diagram. There are circles and rectangles; arrows point in both directions and relationships are all spelled out in functional notations at the bottom of the page. The circles are used to signify "endogenous" or dependent variables and rectangles denote "exogenous" or independent variables. All exogenous variables are used in a strictly nonrecursive fashion: influence can only flow from them to other variables. Endogenous variables can be "recursive" or mutually causative.

For the most part, Figures 5 through 10 show the same relationships as the developmental model. ACCESS FACTORS lead to EXPOSURE. RECEIVER FACTORS effect KNOWLEDGE and EXPOSURE. Because the functional notation is



$$y_1 = f(x_1)$$

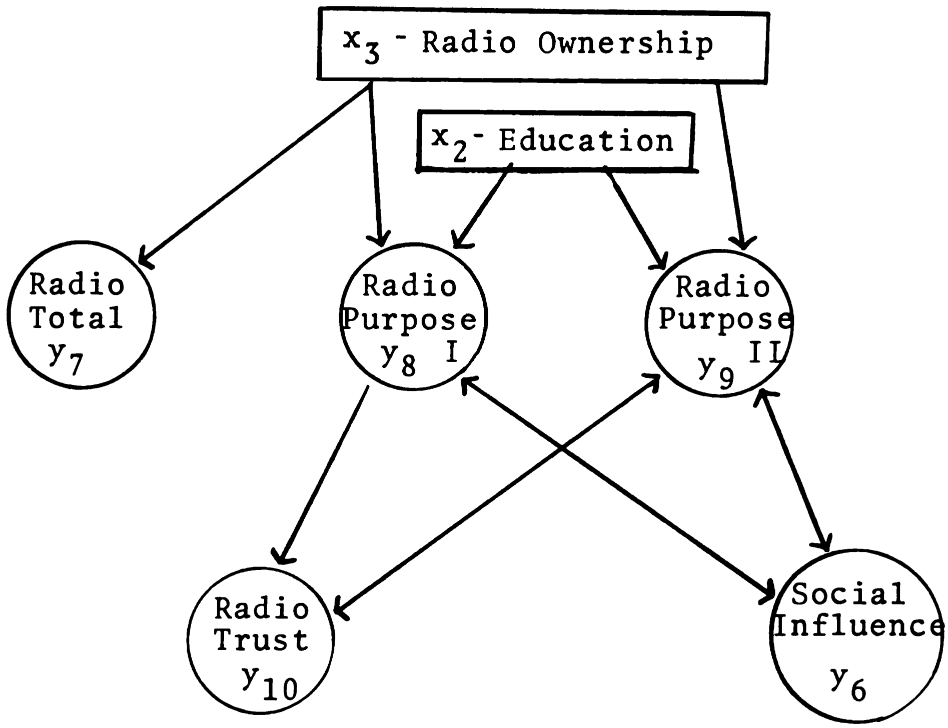
$$y_2 = f(y_1, y_5, y_6, x_1, x_2)$$

$$y_3 = f(y_1, y_6, x_1, x_2)$$

$$y_4 = f(y_6, y_{11}, x_1, x_2)$$

$$y_5 = f(y_2)$$

Figure 5. Reciprocal causation model: print exposure.



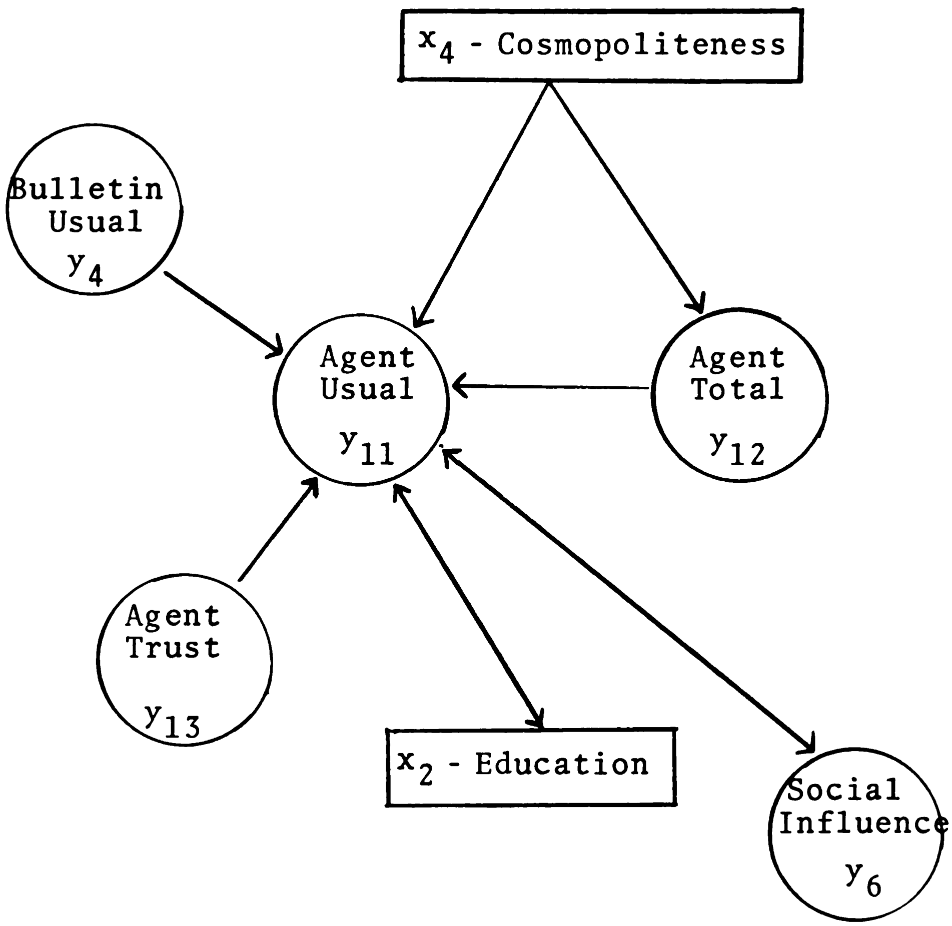
$y_7 = f(x_3)$

$y_8 = f(y_6, y_{10}, x_2, x_3)$

$y_9 = f(y_6, y_{10}, x_2, x_3)$

$y_{10} = f(y_8, y_9)$

Figure 6. Reciprocal causation model: radio exposure.

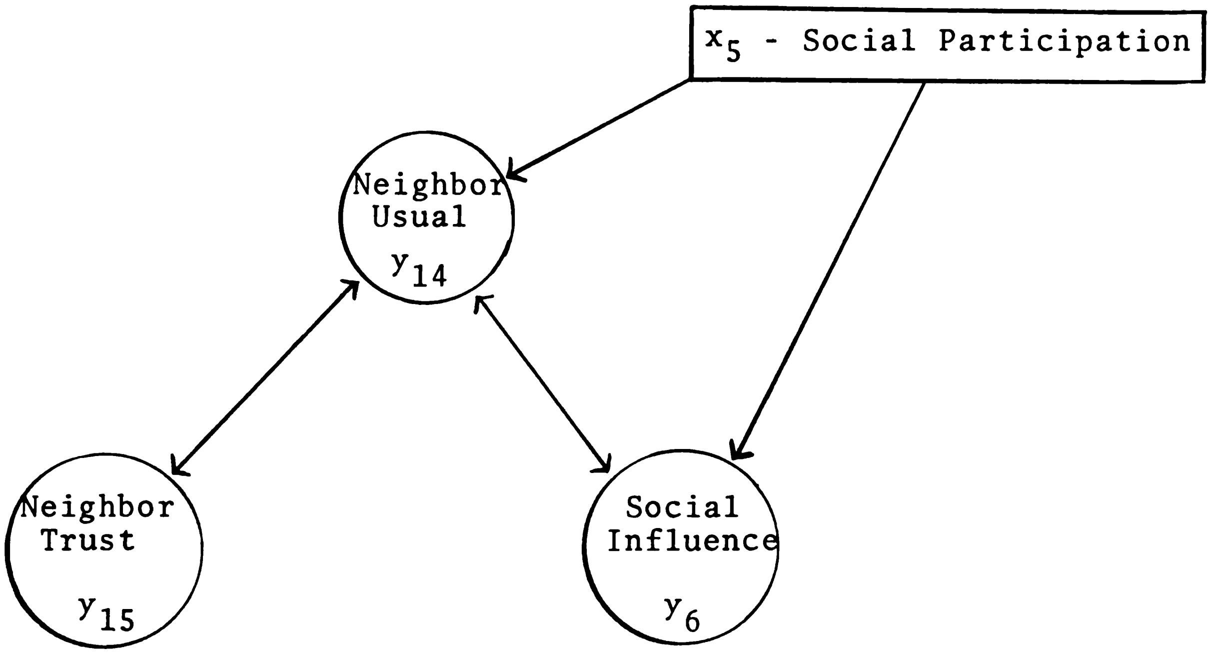


$$y_{11} = f(y_4, y_6, y_{12}, y_{13}, x_2, x_4)$$

$$y_{12} = f(x_4)$$

$$y_{13} = f(y_{11})$$

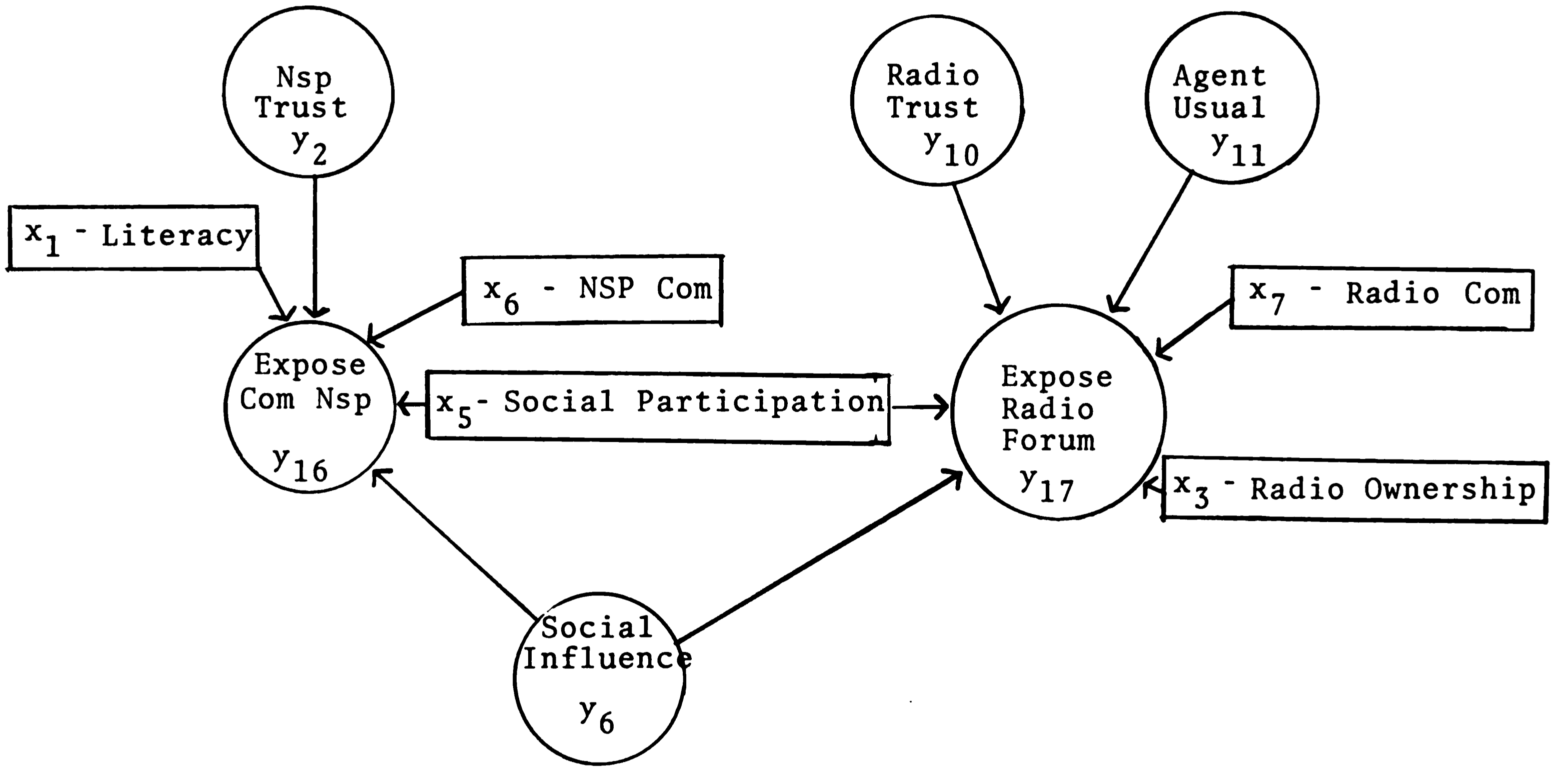
Figure 7. Reciprocal causation model: agent exposure.



$$y_{14} = f(y_6, y_{15}, x_5)$$

$$y_{15} = f(y_{14})$$

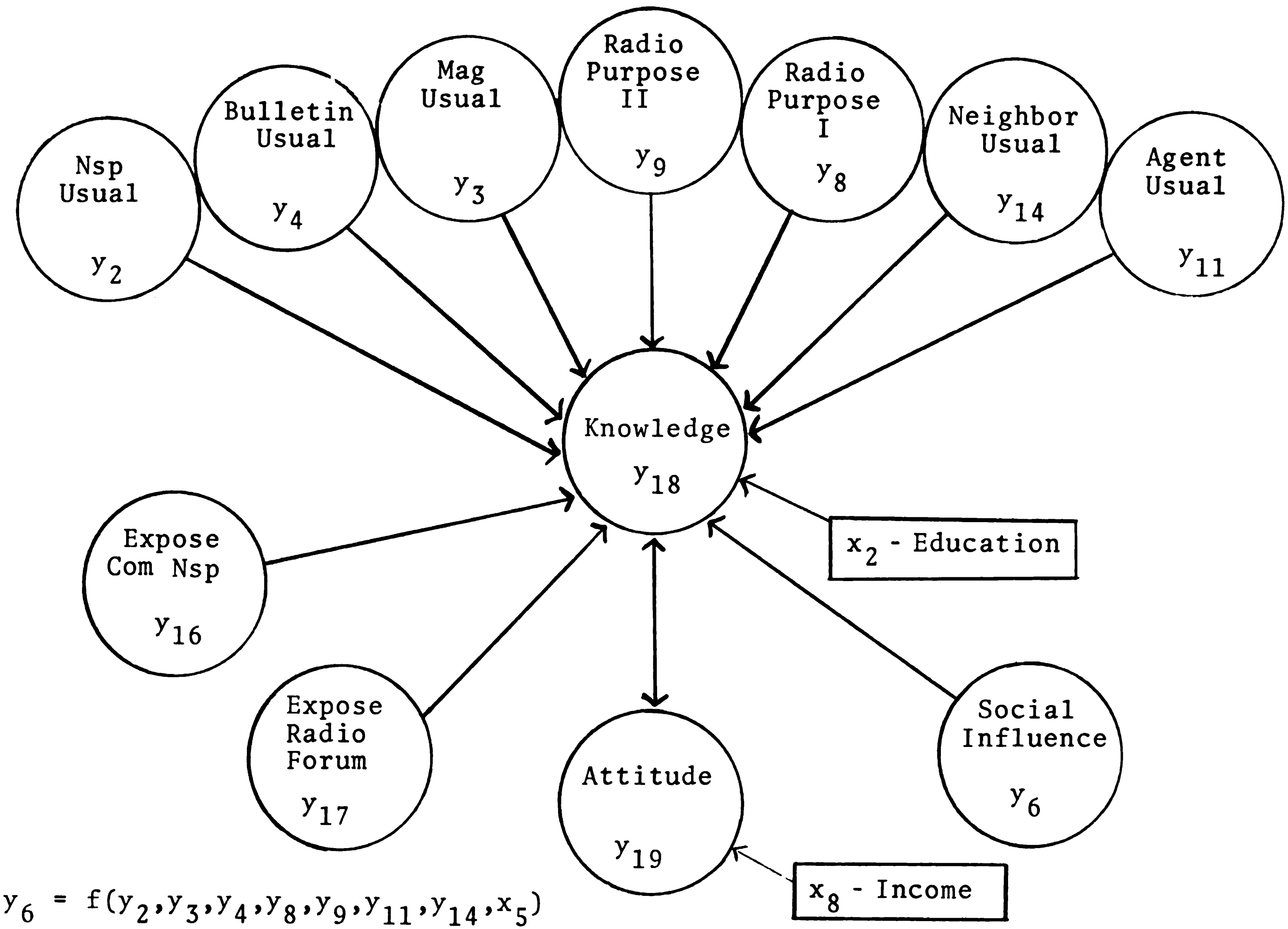
Figure 8. Reciprocal causation model: exposure to neighbor.



$y_{16} = f(y_2, y_6, x_1, x_5, x_6)$

$y_{17} = f(y_6, y_{10}, y_{11}, x_3, x_5, x_7)$

Figure 9. Reciprocal causation model: exposure to experimental treatments.



$y_6 = f(y_2, y_3, y_4, y_8, y_9, y_{11}, y_{14}, x_5)$

$y_{18} = f(y_2, y_3, y_4, y_6, y_8, y_9, y_{11}, y_{14}, y_{16}, y_{17}, y_{19}, x_2)$

$y_{19} = f(y_{18}, x_8)$

Figure 10. Reciprocal causation model: knowledge and attitudes.

more flexible, however, we are also able to specify some less obvious interrelationships. In Figure 5, for example, a reciprocal link is postulated between naming ACAR bulletins as a usual source of agricultural news and reporting ACAR agents as a usual source. Reading the bulletin could produce information seeking <u>or</u> contacts with the agent might lead to interest in the bulletin.

Figures 8 and 9 show the social participation variable in a slightly different role than it occupied in the developmental model. Instead of merely indicating the presence of social networks, it now leads to social influence and to exposure to experimental treatments. As for social influence, the possibility exists that nominations were given on the basis of perceived organizational activities. Thus, we can check to see if the variable reflects such variance. With the treatments, social participation could have created a heightened sense of community involvement or willingness to participate in other groups. Community involvement could lead to interest in a newspaper about the community; willingness to participate could lead to attendance at a forum.

Finally, one other difference between the developmental and reciprocal models should be pointed out. In Figure 9, naming the ACAR agent as a usual source of agricultural information is shown as leading to forum exposure. This connection is postulated in order to check for an experimental artifact. During the time experimental treatments were being conducted, agents were warned not to show any more interest in a community than they would ordinarily. Despite this admonition, some evidence indicated they may have been a bit over-zealous in their promotion of the forum broadcasts and meetings. A significant link between prior contact with the agent and forum exposure would lend substance to our suspicion.

The reciprocal causation model will be tested with a two-stage least-squared regression. This rather complicated technique is described more fully in the next chapter. In essence, it will result in a set of regression equations describing all of the structural relationships in the model. Our confidence in the hypothesized relationships will depend on the significance of the various beta coefficients.

CHAPTER II

METHODOLOGY

This chapter outlines the rationale for causal inferences and describes the general technique of causal path analysis. The blocked indicator and two-stage least-squares regression techniques are discussed in detail.

Introduction

Ordinarily it is not necessary to discuss data analysis techniques in great detail. Most are agreed upon by convention and years of use have made their repeated explication unnecessary. Unfortunately, this is not true of causal path analysis. The philosophical foundations of causal inferences are new and the technique of path analysis is complex. For this reason it will be helpful to provide some background before introducing the blocked indicator and two-stage least-squares modifications.

No attempt will be made to discuss path analysis in detail. There are many issues and several raging controversies which make little difference on a practical level. The purpose of this chapter will be to present the underlying rationale in its briefest form and describe the actual application of methods in enough depth to make replication possible. Detailed references are provided for interested readers.

Causality and Causal Inferences

There is still a controversy concerning the use of causal inferences. A majority of social scientists apparently oppose statements of causality on two grounds: First, the notion of cause and effect is far too simple to describe reality; second, causality can never be verified empirically. These objections are essentially valid but have little scientific utility.

The postulate that everything causes everything else is probably a literal and accurate description of reality. It is, however, analytically useless. The process of relating theory and research always involves postulating theoretical models representing oversimplified versions of reality. Saying that all variables interact with all others does not simplify reality: There will still be too many equations with too many unknowns. Furthermore, the hypothesis of instantaneous causation is something that could never be verified in lab experiments.

The objection that causality can never be verified empirically is also valid in the sense that no theoretically defined concepts can be directly translated into operations and no theoretical propositions can be directly tested. Blalock (1968b) overcomes these objections by assigning causal inferences to the language of theory; thus, to object to causal statements would be to object to theory. Like Northrop (1947) he argues that we must have two different languages--a theoretical and an operational language. Connections between the two can be expressed as auxiliary theories which make our measurement assumptions explicit. Causal inferences are strictly theoretical; causal path analysis lies in the realm of auxiliary theories.

Why do we want to make causal inferences? First, they are useful. As Nagel (1961) concluded, the search for causes is of great utility, regardless of the reality or non-reality of causes, before men formulate statements about the interrelations of events. Second, people appear to think and act in terms of causal inferences. Third, such inferences serve the same function as laws do in the physical sciences--that is, they allow us to talk about ideal states even though the real situation is much more complicated.

Causality, for Blalock (1964), goes beyond the usual Aristotelian definition in that it involves the notion of production. Causes _produce_ effects. This kind of definition cannot be formalized but has certain intuitive and practical advantages. With the notion of production, causal relationships will always be asymetrical. Thus, reciprocal causation is ruled out along with all its complications. This basic postulate allows one to work with complex systems of causal relationships: It is both the model and reason for causal path analysis.

Causal Path Analysis: Assumptions

Ever since Durkheim, social scientists have been attempting to formalize the logic of survey analysis. By the end of the second world war, this formalization was relatively complete (cf. Hyman, 1955; Kendall and Lazarsfeld, 1950), but had only been worked out for the analysis of crossbreaks. An upper limit was usually reached when one attempted to relate more than four or five variables. After this point systems became increasingly complex and difficult to evaluate.

While many scientists are willing to work with simple systems of variables, most realized that complex ones stand a better chance of conforming to reality. A major breakthrough finally occurred when Simon (1954) worked out a formal method for detecting spurious correlations among systems of three variables. Several years later Blalock (1961) extended this method to systems of "N" variables. We now call this method causal path analysis or the "Simon-Blalock method." There are other uses of path analysis (cf. Wright, 1960; Boudon, 1965; Duncan, 1966); throughout this study, however, all references to path analysis will refer to the method developed by Blalock.

Path analysis focuses on the problem of interpretation and does not purport to be a method of discovering causes. Generally speaking, it is a systematic method for eliminating models which are inconsistent with actual data. The great merit of the path analysis scheme is that it makes all assumptions explicit and forces all parts of an argument to be at least internally consistent.

It is readily apparent that path analysis goes beyond the generally accepted logic of hypothesis testing. Instead of testing a null hypothesis against the data, path analysis actually fits a model to the data. This divergence is recognized by Blalock and carefully examined.

Blalock's position is that theory should guide data collection and initial statement of hypotheses. After this point, however, he believes the task of the scientist is to explain his data as well as he can. This is directly contrary to the norm that research consists of the testing of preconceived hypotheses and that findings not thought of beforehand are rejected or accepted as tentative.

Wiggins (1968) developed a powerful formal argument of Blalock's position. He starts with the assumption:

> The probability that one dependent variable has multiple causes is greater than the probability that it is caused by a single independent variable.

This assumption has two correlaries:

1. If a hypothesis were disproved through the prescribed scientific procedure it could be discarded in favor of other possible alternative hypotheses.

2. If a second hypothesis were not disproved by the same procedures, it would not be discarded; however, because of alternative undisproved hypotheses it could not be proved.

These statements led Wiggins to the following conclusions: The task of science is not proving hypotheses, it is rejecting or disproving hypotheses.

Now, since hypotheses can only be discarded, it follows that empirical investigations should test as many alternative hypotheses as possible. We cannot accept any hypothesis as proven, but we should reject as many inadequate hypotheses as we can. From this point of view, Wiggins criticizes those scientists who only test their preconceived hypotheses: Such practices are tantamount to experimenter artifacts.

While causal path analysis does allow the investigator to examine questions beyond his original intent it does not constitute a wide open fishing expedition. In the process of analysis it becomes readily apparent that one must have relatively sound reasons for postulating alternative causal paths. With more than four variables the number of possible models becomes so large that it is generally impossible to fit data except by chance alone. Numerous constraints must be applied and these constraints must be guided by theory.

This brief exposition can hardly indicate the depth and breadth of Blalock's rationale. However, an example of how Blalock proceeds through an analysis should clarify how and why he is able to reject alternative hypotheses.

Causal Path Analysis: Method

Before attempting to perform a causal path analysis of a complex system of variables several questions must be asked:

1. Are temporal sequences and theoretic rationales sufficiently obvious that one-way causation can be assumed?
2. Are the measured variables actually the ones in which there is theoretical interest? If not, how are they presumably linked with these variables?
3. What kinds of measurement errors can be expected and what do they imply?

Obviously, to answer these questions one must have a fairly extensive theoretic rationale as well as an idea of what is being measured and how operations mesh with theory.

Assuming for the moment that one has some justification for hypothesizing causal relationships the first step in path analysis is to set up a series of recursive equations based on theoretical expectations. These equations are the working material of path analysis.

The development of such equations is not obvious. In an experiment the effect of the independent variable on the dependent variable can be represented with an equation of the following form:

$$y_i = a + bx_i + e$$

This will not be generally possible for non-experimental situations where controls are lacking. Here there will be many variables that are dependent on other variables.

Economists have developed methods of modeling non-experimental situations with entire sets of simultaneous equations called "structural systems." For example,

$$x_1 = a_1 + b_{12}x_2 + b_{13}x_3 + \dots b_{1k}x_k + e_1$$

$$x_2 = a_2 + b_{21}x_1 + b_{23}x_3 + \dots b_{2k}x_k + e_2$$

$$\vdots$$

$$x_k = a_k + b_{k1}x_1 + b_{k2}x_2 + \dots b_{k,k-1}x_{k-1} + e_k$$

These equations are non-recursive: They signify that each variable in the system can have an effect on each other variable in the system. The error terms refer to the possibility that other variables not included in the system also have an effect on each dependent variable and that certain measurement error will occur.

While these equations are a "best" representation of what is happening in the system, they cannot be solved to give unique solutions for there are too many unknowns. This problem is solved by assuming that some variables do not cause others. A set of recursive equations will result from this procedure. In effect they are constructed by taking the previous set of equations and assuming that certain relationships are only asymetrical. More precisely, certain "b" terms are assumed to $\longrightarrow 0$. For example,

$$x_1 = e_1$$

$$x_2 = b_{21}x_1 + e_2$$

$$x_3 = b_{31}x_1 + b_{32}x_2 + e_3$$

$$x_4 = b_{41}x_1 + b_{42}x_2 + b_{43}x_3 + e_4$$

This is now a causal model.

All causal models have three characteristics: First, a set of explicitly defined variables; second, certain assumptions about how variables are related causally; and third, an assumption that error terms are uncorrelated. This last feature is very important. Error terms represent, along with random and measurement error, the error caused by leaving out variables. In other words, if a variable left out of the analysis affects both x_1 and x_2, solutions will be incorrect. Although this has little practical significance since it is impossible to evaluate precisely what is left out, it serves as a serious caveat to those who would draw strong conclusions from their models.

The next step, which was Simon's original contribution, involves the creation of alternative models. Here one seeks to eliminate further connections between variables. This process is equivalent to setting certain partial correlation coefficients equal to zero. For example, the model

$$x_1 \longrightarrow x_2 \longrightarrow x_3 \longrightarrow x_4$$

implies that

$$r_{13\cdot 2} = 0, \; r_{24\cdot 3} = 0, \; r_{14\cdot 23} = 0.$$

On the other hand, the model

$$\begin{tikzcd} x_1 \arrow[r] \arrow[d] & x_2 \arrow[d] \arrow[dl] \\ x_4 & x_3 \end{tikzcd}$$

implies that

$$r_{13\cdot 2} = 0, \; r_{24\cdot 3} \neq 0, \; r_{34} = 0, \; r_{14\cdot 23} \neq 0$$

Since differential predictions are made, the alternative models can be evaluated against one another: The one with the poorest fit to the real data is rejected.

Blalock takes a short cut which simplifies the evaluation of alternatives. He noted that r_{13} could also be expressed as r_{12} x r_{13}. Therefore, he could evaluate different models without calculating exact partials. All this becomes clear in the following example.

In an example previously used in his first detailed explication of causal analysis, Blalock (1964) sought to determine which of two models best fit his actual data.

He had sound theoretical reasons for expecting that the models could be either:

Model 1 $\quad w \longrightarrow x \longrightarrow y \longrightarrow z$ or,

Model II

$$\begin{tikzcd} w \arrow[r] \arrow[dr] & x \arrow[d] \\ z & y \arrow[l] \end{tikzcd}$$

The following set of intercorrelations were used to calculate actual and predicted degrees of fit for each model:

Actual Correlations

	w	x	y	z
w				
x	.49			
y	.53	.61		
z	.39	.51	.80	

Predictions		Degrees to Fit		
Model I	Actual			Predicted
$r_{xz} = r_{xy}r_{yz}$	.51	vs.	.49 =	(.61)(.80)
$r_{wy} = r_{wx}r_{xy}$	.53	vs.	.30 =	(.49)(.61)
$r_{wz} = r_{wx}r_{xy}r_{yz}$	.39	vs.	.24 =	(.49)(.61)(.80)
Model II				
$r_{xz} = r_{xy}r_{yz}$	.51	vs.	.49 =	(.61)(.80)
$r_{wz} = r_{wy}r_{yz}$	.39	vs.	.42 =	(.53)(.80)

Since Model II does not predict that x intervenes between w and y (it is a codeterminate), it does not have the bad fit (.53 vs. .30) shown in Model I. Furthermore, because it postualtes only y between w and z, its prediction fits better than Model I. There are clear grounds for deciding between the two models and Model II obviously provides better predictions.

This technique can be applied to larger systems of variables. When one model does not fit very well it can be modified by systematically changing arrows around until a best fit is achieved. By rejecting models which do not fit we gain greater confidence in our final model.

As mentioned previously, the major justification of the path analysis scheme is that it makes the assumption explicit. With the causal scheme made explicit criticism can be sharply focused, and, hence, potentially relevant not only for the current interpretation at hand but also to the conduct of future research.

On the surface this appears to be a useful and relatively uncomplicated technique. Blalock carefully acknowledges, however, the possibility of three problems that could radically influence the inferences we draw from data: First, errors can be produced by faulty assumptions about omitted variables; second, errors can be produced from assumptions about linearity and additivity; and third, errors can be produced by faulty assumptions about the lack of measurement errors.

In this particular case the large number of variables used in the blocked indicator model allows us to partially evaluate the possibility of omitted variables. True, we must rely on untestable speculation but such inferences can at least be more extensive given the greater number of variables. Problem two is particularly important. Scatter diagrams could be drawn or etas calculated for all first order correlations to check assumptions about linearity. Similarly, all first order interactions could be run out and tested for significance. Unfortunately when the number of variables becomes so large both checks become next to impossible. Third, the multiple indicator approach does give some insight into potential measurement errors but only to the extent that it enables us to avoid index variables. For obvious reasons, most analysis of these three cautions will be found in the Discussion Section.

"Causal models" as Blalock (1971, p. 1) stated in his most recent volume, "have become an increasingly important tool of the social scientists." Not only have different disciplines adopted such models for their substantive areas but numerous technical modifications are also occurring. In the following pages elaborations on the basic notions of path analysis will be discussed.

Blocked Indicator Approach

Path analysis provided a systematic method for analysing relationships between a larger number of variables than ever before possible. There is a practical limit, however, to the number of such variables that can be considered. Five or six present no problems but the calculations and manipulation for larger numbers become increasingly tedious. The blocked indicator approach is one technique for extending causal path analysis to larger systems of variables.

Testing of a complex model usually involves a problem in the selection of indicators. One solution is to choose the "best" indicator for conceptual reasons. Another is to combine three or four variables into an index. Both of these methods, while they are most common, involve a loss of information and conceptual oversimplification.

The advantages of multiple indicators have long been apparent. Curtis and Jackson (1962), for example, mention at least three advantages of using multiple indicators instead of indices: First, multiple indicators increase the number of predictions made by a particular model; second, they enable the careful researcher to determine the existence of an unknown spurious cause; and third, they increase one's confidence in the validity of the indicators and help guide conceptual reformulation.

On a more theoretical plane, other authors (Webb, et al., 1966; Blalock, 1969) discussed and illustrated the use of multiple indicators to determine the existence and nature of measurement errors.

As mentioned, multiple indicators present one basic problem: They are unwieldy. Recently, Sullivan (1971) proposed the use of multiple-partial correlation coefficients and blocked indicators as a solution to the problem. The method is actually quite simple. Indicators of the dependent variables are used separately but indicators of independent or control variables can only operate in a block. Thus, there will be more tests of each prediction (as many as there are indicators for the dependent variable) and also a more accurate representation of the theoretical constructs. The following simple example makes this clear.

Suppose we postulate a causal relationship between three variables. Variable "A" is indicated by two variables, variable "B" is indicated by three variables and variable "C" is indicated by four variables. In the following model, the correlation between block A and block C should become zero when controlling for block B

BLOCK A BLOCK B BLOCK C

$$\boxed{a_1, a_2} \longrightarrow \boxed{b_1, b_2, b_3} \longrightarrow \boxed{c_1, c_2, c_3, c_4}$$

There are four tests of this prediction:

$$r_{c_1(a_1a_2)\cdot(b_1b_2b_3)} = 0$$

$$r_{c_2(a_1a_2)\cdot(b_1b_2b_3)} = 0$$

$$r_{c_3(a_1a_2)\cdot(b_1b_2b_3)} = 0$$

$$r_{c_4(a_1a_2)\cdot(b_1b_2b_3)} = 0$$

In effect, we allow all the indicators of B to wipe out as much variance in C as possible and then see if the remaining variation can be explained by the indicators of the independent variable. Sullivan advocated testing both the predictions (e.g. $AC\cdot B=0$) and the assumptions (e.g. $AB\neq 0$) of each model. He successfully applied the method to real data.

The use of multiple-partial correlation coefficients with blocked indicators has several advantages. First and foremost, it permits the application of all the indicators while retaining a manageable number of predictions. Second, tests are more dependent on conceptual notions than on empirical criteria. That is, we use variables because we believe they are conceptual indicators rather than because they were all loaded on the same factor. Finally, we can ignore the interrelationships between variables within each block; they may take any form, including reciprocal causation.

The theoretical foundations for the general communication model have already been established. Let us now spell out the precise assumptions and predictions for the Brazil data in terms of multiple-partial correlation coefficients.

Blocked Indicator Model: Assumptions and Predictions

Predicted and assumed relationships for the Brazil variables are diagrammed in Figures 3 and 4. Counting exposure to experimental treatments there are twenty-seven variables. This is an extremely large number for a causal path analysis and is a bit unwieldy even with the use of multiple-partials.

Sullivan made a point of separating assumed relationships from predicted relationships. Predicted relationships, in general, were those in which correlation coefficients were expected to be approximately equal to zero. In Figure 3, for example, total exposure is expected to intervene between ACCESS FACTORS and KNOWLEDGE. Expressed as a multiple-partial correlation this prediction becomes $r_{g_1(a_1a_2a_3a_4a_5)\cdot(c_1c_2c_3)} = 0$. Similarly, ACCESS FACTORS, RECEIVER FACTORS and ENABLING FACTORS are predicted to be unrelated (e.g. $r_{AF}=r_{AI}=r_{FI} = 0$). In this case, and in the case of most assumed relationships, we are faced with a dilemma.

The advantage of using multiple-partials to test the effects of predicted intervening variables is obvious: If done separately, the test of $r_{AE \cdot D} = 0$ alone would require 140 partial correlations instead of four multiple-partials. With first-order correlations, both predicted and assumed, the advantages are not as great. Here, for example, all combinations of indicators to test the prediction $r_{AF} = 0$ would require 15 first order correlations instead of five multiple correlations. Faced with a similar decision (but a smaller number of indicators) Sullivan opted for all possible first order correlations because the greater detail allowed him to evaluate the exact contribution of each variable.

A similar procedure will be followed in this study. For those relationships where first order correlations are predicted or assumed all possible combinations of indicators will be evaluated. This will result in a certain amount of tedium. On the other hand, Sullivan was able to find an inappropriate variable with this approach. Perhaps we will be able to do the same.

Assumptions, in contrast to predictions, indicate that significant relationships are expected between certain blocks of indicators. ACCESS FACTORS, for example, are assumed to cause all EXPOSURE variables. This is expressed as $r_{AB} \neq 0$, $r_{AC} \neq 0$, $r_{AD} \neq 0$. We also wish to evaluate more complicated assumptions. RECEIVER FACTORS are hypothesized to cause both EXPOSURE and KNOWLEDGE. It is possible, however, that EXPOSURE FACTORS intervene between RECEIVER FACTORS and KNOWLEDGE. To examine this possibility, we evaluate the assumptions $r_{FG \cdot C} \neq 0$, $r_{FG \cdot D} \neq 0$.

Predictions for blocks of variables are listed in Tables 1 and 2. Again, for practical reasons the experimental treatments are separated from the general model. Assumptions are listed in Tables 3 and 4. The exact correlations and significance tests are presented in the Results chapter.

Table 1. Predictions for Figure 3--general model.

1. $r_{EA \cdot B} = 0$	12. $r_{BH} = 0$
2. $r_{EA \cdot C} = 0$	13. $r_{BI} = 0$
3. $r_{EA \cdot D} = 0$	14. $r_{HC \cdot G} = 0$
4. $r_{AF} = 0$	15. $r_{CI} = 0$
5. $r_{GA \cdot C} = 0$	16. $r_{HD \cdot G} = 0$
6. $r_{GA \cdot D} = 0$	17. $r_{DI} = 0$
7. $r_{HA \cdot CG} = 0$	18. $r_{HE} = 0$
8. $r_{HA \cdot DG} = 0$	19. $r_{EI} = 0$
9. $r_{AI} = 0$	20. $r_{HF \cdot D} = 0$
10. $r_{GB} = 0$	21. $r_{FI} = 0$
11. $r_{FB} = 0$	22. $r_{GI} = 0$

Table 2. Predictions for Figure 4--experimental treatments.

1. $r_{GA \cdot R} = 0$	5. $r_{HR \cdot G} = 0$
2. $r_{GA \cdot N} = 0$	6. $r_{HN \cdot G} = 0$
3. $r_{GE \cdot R} = 0$	7. $r_{RI} = 0$
4. $r_{GE\ N} = 0$	8. $r_{NI} = 0$

Table 3. Assumptions for Figure 3--general model.

1. $r_{AB} \neq 0$	10. $r_{DF} \neq 0$
2. $r_{AC} \neq 0$	11. $r_{EF} \neq 0$
3. $r_{AD} \neq 0$	12. $r_{FG} \neq 0$
4. $r_{BE} \neq 0$	13. $r_{GH} \neq 0$
5. $r_{CE} \neq 0$	14. $r_{HI} \neq 0$
6. $r_{DE} \neq 0$	15. $r_{EF \cdot C} \neq 0$
7. $r_{CG} \neq 0$	16. $r_{EF \cdot D} \neq 0$
8. $r_{DG} \neq 0$	17. $r_{GF \cdot C} \neq 0$
9. $r_{CF} \neq 0$	18. $r_{GF \cdot D} \neq 0$

Table 4. Assumptions for Figure 4--experimental treatments.

1. $r_{AR} \neq 0$	6. $r_{FN} \neq 0$
2. $r_{AN} \neq 0$	7. $r_{GR} \neq 0$
3. $r_{ER} \neq 0$	8. $r_{GN} \neq 0$
4. $r_{EN} \neq 0$	9. $r_{GF \cdot N} \neq 0$
5. $r_{FR} \neq 0$	10. $r_{GF \cdot R} \neq 0$

Two-Stage Least-Squares Regression: Assumptions

It should be noted that the Simon-Blalock procedure is not a prerequisite for doing a causal path analysis. The choice of which method to use depends on the nature of the data and the purpose of the research. Most importantly, assumptions used to identify a system (e.g. that certain coefficients are zero) are never strictly correct. Therefore, the question arises as to the seriousness of the errors produced whenever these assumptions are, in fact, invalid.

Our blocked indicator model assumes strictly causal connections between all blocks of indicators. These assumptions are needed in order to operate on the data in particular ways. What happens if we are wrong? What happens if reciprocal causation is occurring? This question has been extensively considered by econometricians.

On the one hand, Fisher and Andro (1962) developed a general theorem to the effect that as long as assumptions are approximately correct we can count on only minor distortions in our estimates. They argued that even inferences about long-run dynamic modes (such as our general communication model) can be reasonably safe. Conversely, they noted that assumptions which were totally unjustified empirically will produce misleading results. For this reason it is advisable to have a reasonably sound theory and prior empirical research before making assumptions.

Where does this leave us? Econometrics is probably the most advanced of the social sciences and has relatively sound theories and prior research. Obviously, this is not true of the field of communication: Assumptions are highly tentative and based on speculative theory and slender evidence. Fortunately, methods have also been developed for evaluating models with a minimum number of assumptions. These methods involve extensions of simultaneous equation techniques.

Any system of variables can be represented by a set of simultaneous equations. In such a model it is impossible to uniquely estimate the relative effects of each variable on the others when reciprocal causation is allowed among all variables. Therefore an attempt must be made to reduce the number of mutually causative elements either by introducing predetermined variables (exogenous variables) or assuming that certain variables are really lagged values of the interdependent endogenous variables.

Blalock (1966) proposed a simple rule which allows one to exactly "identify" a variable with the least number of predetermined variables necessary. Paraphrased, the rule requires that the number of endogenous variables appearing in any given equation cannot be greater than one more than the number of exogenous variables left out of this equation. When there are more endogenous variables than the rule allows an equation is said to be underidentified. When there are less endogenous variables than exogenous the equation is called overidentified. Underidentified equations cannot be solved for unique solutions but overidentified ones can in several different ways.

The general problem of identification is a large one and its solution is not intuitively obvious. In fact, the rationale, like Chinese food, has the annoying quality of leaving the reader empty immediately after reading. A full discussion is both unnecessary and beyond the scope of this study. Interested readers are referred to Blalock's (1971) chapter on simultaneous equation techniques and to Christ's (1966) basic work on econometric models.

In this study all but one of the equations will be overidentified. This is neither unwelcome nor unusual. It is very seldom that a social scientific theory is developed enough to yield exactly identified equations. Blalock (1971) argues as a general principle that the less sure we are of our theories the more desirable it is to have equations overidentified. In this case, multiple predictions can be made from the excess variables and we gain greater confidence.

As mentioned, there are several different techniques for solving overidentified equations. While he alluded to an extensive literature on the question, Blalock (1971) felt the two-stage least-squares technique was most adequate for less advanced fields such as political science and sociology. It is quite robust and apparently less subject to the errors produced by poor measurement procedures and very tentative theory.

Two-Stage Least-Squares Regression: Method

The two-stage least-squares estimation technique is also called the Theil-Basmann Method after its co-developers. A more or less complete mathematical and statistical justification for this technique can be found elsewhere (Theil, 1953; Basmann, 1957) and will not be included here. An attempt will be made, instead, to show how the important equations are derived. The following exposition owes a great deal to Mason and Halter's (1968) application of two-stage least-squares estimation to an innovation diffusion model.

The first step is to propose a set of equations with endogenous and exogenous variables and error terms. These are the same equations found in Figures 5 through 10. Nineteen equations are listed in Table 5.

Equation 18, as mentioned previously, is under-identified; there are four too many endogenous variables. A practical solution to this problem can be created in two steps. First, the estimated ($\hat{y}$) values of the three

Table 5. Primary equations--reciprocal causation model.

1.	$y_1 = f(x_1)$
2.	$y_2 = f(y_1, y_5, y_6, x_1, x_2)$
3.	$y_3 = f(y_1, y_6, x_1, x_2)$
4.	$y_4 = f(y_6, y_{11}, x_1, x_2)$
5.	$y_5 = f(y_2)$
6.	$y_6 = f(y_2, y_3, y_4, y_8, y_9, y_{11}, y_{14}, x_5)$
7.	$y_7 = f(x_3)$
8.	$y_8 = f(y_6, y_{10}, x_2, x_3)$
9.	$y_9 = f(y_6, y_{10}, x_2, x_3)$
10.	$y_{10} = f(y_8, y_9)$
11.	$y_{11} = f(y_4, y_6, y_{12}, y_{13}, x_2, x_4)$
12.	$y_{12} = f(x_4)$
13.	$y_{13} = f(y_{11})$
14.	$y_{14} = f(y_6, y_{15}, x_5)$
15.	$y_{15} = f(y_{14})$
16.	$y_{16} = f(y_2, y_6, x_1, x_5, x_6)$
17.	$y_{17} = f(y_6, y_{10}, y_{11}, x_3, x_5, x_7)$
18.	$y_{18} = f(y_2, y_3, y_4, y_6, y_8, y_9, y_{11}, y_{14}, y_{16}, y_{17}, y_{19}, x_2)$
19.	$y_{19} = f(y_{18}, x_8)$

print exposure variables will be summed to an index. Second, the two radio exposure variables will be summed to an index. Third, on the basis of the blocked indicator results, the least useful of the remaining variables will be eliminated from the equation. A better solution could have been accomplished by the addition of three more exogenous variables. Unfortunately, the supply of such variables has been exhausted.

The second step is to express all the primary equations strictly in terms of exogenous variables. These are called "reduced form equations" and are listed in Table 6. Since each equation contains only one endogenous variable, the coefficients in each of these equations can be estimated by ordinary least-squares regression.

Having obtained the coefficients from the reduced form equations, the next step is to generate estimated ($\hat{y}$) values. A short computer program will be written in which the twenty reduced form equations without error terms will be used to create new ($\hat{y}$) values for each subject. For application of the two-stage procedure it is assumed that error is due to omission of variables and not to errors of measurement. Obviously, this is quite an inferential leap. Although some authorities (Ezekial and Fox, 1959) originally questioned the support for such assumptions, this short-cut has become quite wide spread in the field of economics (cf. Blalock, 1971).

Table 6. Reduced form equations--reciprocal causation model.

1. $\hat{y}_1 = c_1 + b_{11}x_1 + b_{12}x_2 + b_{13}x_3 + b_{14}x_4 + b_{15}x_5 + b_{16}x_6 + b_{17}x_7 + b_{18}x_8$
2. $\hat{y}_2 = c_2 + b_{21}x_1 + b_{22}x_2 + b_{23}x_3 + b_{24}x_4 + b_{25}x_5 + b_{26}x_6 + b_{27}x_7 + b_{28}x_8$
3. $\hat{y}_3 = c_3 + b_{31}x_1 + b_{32}x_2 + b_{33}x_3 + b_{34}x_4 + b_{35}x_5 + b_{36}x_6 + b_{37}x_7 + b_{38}x_8$
4. $\hat{y}_4 = c_4 + b_{41}x_1 + b_{42}x_2 + b_{43}x_3 + b_{44}x_4 + b_{45}x_5 + b_{46}x_6 + b_{47}x_7 + b_{48}x_8$
5. $\hat{y}_5 = c_5 + b_{51}x_1 + b_{52}x_2 + b_{53}x_3 + b_{54}x_4 + b_{55}x_5 + b_{56}x_6 + b_{57}x_7 + b_{58}x_8$
6. $\hat{y}_6 = c_6 + b_{61}x_1 + b_{62}x_2 + b_{63}x_3 + b_{64}x_4 + b_{65}x_5 + b_{66}x_6 + b_{67}x_7 + b_{68}x_8$
7. $\hat{y}_7 = c_7 + b_{71}x_1 + b_{72}x_2 + b_{73}x_3 + b_{74}x_4 + b_{75}x_5 + b_{76}x_6 + b_{77}x_7 + b_{78}x_8$
8. $\hat{y}_8 = c_8 + b_{81}x_1 + b_{82}x_2 + b_{83}x_3 + b_{84}x_4 + b_{85}x_5 + b_{86}x_6 + b_{87}x_7 + b_{88}x_8$
9. $\hat{y}_9 = c_9 + b_{91}x_1 + b_{92}x_2 + b_{93}x_3 + b_{94}x_4 + b_{95}x_5 + b_{96}x_6 + b_{97}x_7 + b_{98}x_8$
10. $\hat{y}_{10} = c_{10} + b_{10,1}x_1 + b_{10,2}x_2 + b_{10,3}x_3 + b_{10,4}x_4 + b_{10,5}x_5 + b_{10,6}x_6 + b_{10,7}x_7 + b_{10,8}x_8$

Table 6.--Continued.

11. $\hat{y}_{11} = c_{11} + b_{11,1}x_1 + b_{11,2}x_2 + b_{11,3}x_3 + b_{11,4}x_4 + b_{11,5}x_5 + b_{11,6}x_6 + b_{11,7}x_7 + b_{11,8}x_8$

12. $\hat{y}_{12} = c_{12} + b_{12,1}x_1 + b_{12,2}x_2 + b_{12,3}x_3 + b_{12,4}x_4 + b_{12,5}x_5 + b_{12,6}x_6 + b_{12,7}x_7 + b_{11,8}x_8$

13. $\hat{y}_{13} = c_{13} + b_{13,1}x_1 + b_{13,2}x_2 + b_{13,3}x_3 + b_{13,4}x_4 + b_{13,5}x_5 + b_{13,6}x_6 + b_{13,7}x_7 + b_{13,8}x_8$

14. $\hat{y}_{14} = c_{14} + b_{14,1}x_1 + b_{14,2}x_2 + b_{14,3}x_3 + b_{14,4}x_4 + b_{14,5}x_5 + b_{14,6}x_6 + b_{14,7}x_7 + b_{14,8}x_8$

15. $\hat{y}_{15} + c_{15} + b_{15,1}x_1 + b_{15,2}x_2 + b_{15,3}x_3 + b_{15,4}x_4 + b_{15,5}x_5 + b_{15,6}x_6 + b_{15,7}x_7 + b_{15,8}x_8$

16. $\hat{y}_{16} + c_{16} + b_{16,1}x_1 + b_{16,2}x_2 + b_{16,3}x_3 + b_{16,4}x_4 + b_{16,5}x_5 + b_{16,6}x_6 + b_{16,7}x_7 + b_{16,8}x_8$

17. $\hat{y}_{17} + c_{17} + b_{17,1}x_1 + b_{17,2}x_2 + b_{17,3}x_3 + b_{17,4}x_4 + b_{17,5}x_5 + b_{17,6}x_6 + b_{17,7}x_7 + b_{17,8}x_8$

18. $\hat{y}_{18} + c_{18} + b_{18,1}x_1 + b_{18,2}x_2 + b_{18,3}x_3 + b_{18,4}x_4 + b_{18,5}x_5 + b_{18,6}x_6 + b_{18,7}x_7 + b_{18,8}x_8$

19. $\hat{y}_{19} + c_{19} + b_{19,1}x_1 + b_{19,2}x_2 + b_{19,3}x_3 + b_{19,4}x_4 + b_{19,5}x_5 + b_{19,6}x_6 + b_{19,7}x_7 + b_{19,8}x_8$

The final step consists of plugging in the newly estimated $\hat{y}$ values on the right hand side of the primary equations. Original y values appear on the left-hand side of the equations and the original exogenous variables remain as they were. These final equations, called "structural equations," are shown in Table 7. Equation 18, still under-identified, will be shown in its final form in Chapter IV.

The structural equations are estimated with an ordinary lest-squares regression, and an F-test is used to evaluate the significance of the final beta coefficients. These tests tell us to what degree we can have confidence in the relationships hypothesized for the reciprocal causation model.

In summary, there are seven major steps in the two-stage least-squares regression analysis:

1. Primary equations are created to describe all relationships in the hypothetical model.
2. By substituting exogenous variables for all the endogenous variables on the right hand side of the equations a series of reduced form equations are produced.
3. Reduced form equations are estimated by ordinary least-squares regression.
4. Reduced form equations, weighted by their beta coefficients are used to generate a set of estimated $\hat{y}$ values.

Table 7. Structural equations--reciprocal causation model.

1. $y_1 = c_1 + \beta_{11}x_1$
2. $y_2 = c_2 + \beta_{21}\hat{y}_1 + \beta_{22}\hat{y}_5 + \beta_{23}\hat{y}_6 + \beta_{24}x_1 + \beta_{25}x_2$
3. $y_3 = c_3 + \beta_{31}\hat{y}_1 + \beta_{32}\hat{y}_6 + \beta_{33}x_1 + \beta_{34}x_2$
4. $y_4 = c_4 + \beta_{41}\hat{y}_6 + \beta_{42}\hat{y}_{11} + \beta_{43}x_1 + \beta_{44}x_2$
5. $y_5 + c_5 + \beta_{51}\hat{y}_2$
6. $y_6 = c_6 + \beta_{61}\hat{y}_2 + \beta_{62}\hat{y}_3 + \beta_{63}\hat{y}_4 + \beta_{64}\hat{y}_8 + \beta_{65}\hat{y}_9 + \beta_{66}\hat{y}_{11}$
   $+ \beta_{67}\hat{y}_{14} + \beta_{68}x_5$
7. $y_7 = c_7 + \beta_{71}x_3$
8. $y_8 = c_8 + \beta_{81}\hat{y}_6 + \beta_{82}\hat{y}_{10} + \beta_{83}x_2 + \beta_{84}x_3$
9. $y_9 = c_9 + \beta_{91}\hat{y}_6 + \beta_{92}\hat{y}_{10} + \beta_{93}x_2 + {}_{94}x_3$
10. $y_{10} = c_{10} + \beta_{10,1}\hat{y}_8 + \beta_{10,2}\hat{y}_9$
11. $y_{11} = c_{11} + \beta_{11,1}\hat{y}_4 + \beta_{11,2}\hat{y}_6 + \beta_{11,3}\hat{y}_{12} + \beta_{11,4}\hat{y}_{13}$
    $+ \beta_{11,5}x_2 + \beta_{11,6}x_4$
12. $y_{12} = c_{12} + \beta_{12,1}x_4$
13. $y_{13} = c_{13} + \beta_{13,1}\hat{y}_{11}$
14. $y_{14} = c_{14} + \beta_{14,1}\hat{y}_6 + \beta_{14,2}\hat{y}_{15} + \beta_{14,3}x_5$
15. $y_{15} = c_{15} + \beta_{15,1}\hat{y}_{14}$
16. $y_{16} = c_{16} + \beta_{16,1}\hat{y}_2 + \beta_{16,2}\hat{y}_6 + \beta_{16,3}x_1 + \beta_{16,4}x_5 + \beta_{16,5}x_6$
17. $y_{17} = c_{17} + \beta_{17,1}\hat{y}_6 + \beta_{17,2}\hat{y}_{10} + \beta_{17,3}\hat{y}_{11} + \beta_{17,4}x_3$
    $+ \beta_{17,5}x_5 + \beta_{17,6}x_7$
18. $y_{18} = c_{18} + \beta_{18,1}\hat{y}_2 + \beta_{18,2}\hat{y}_3 + \beta_{18,3}\hat{y}_4 + \beta_{18,4}\hat{y}_6$
    $+ \beta_{18,5}\hat{y}_8 + \beta_{18,6}\hat{y}_9 + \beta_{18,7}\hat{y}_{11} + \beta_{18,8}\hat{y}_{14}$
    $+ \beta_{18,9}\hat{y}_{16} + \beta_{18,10}\hat{y}_{17} + \beta_{18,11}\hat{y}_{19} + \beta_{18,12}x_2$
19. $y_{19} = c_{19} + \beta_{19,1}\hat{y}_{18} + \beta_{19,2}x_8$

5. Estimated $\hat{y}$ values are substituted for the original values on the right hand side of the primary equations.

6. The resulting structural equations are estimated with ordinary least-squares regression.

7. Coefficients in the final structural equations are tested for significance.

Exact values for beta coefficients in both the reduced form and final structural equations are presented in Chapter IV. Their implications are examined and evaluated in Chapter V.

CHAPTER III

DESIGN

In this chapter major aspects of the Brazilian Field Experiment are outlined. The design and specific communication treatments are briefly described. Specific operational definitions are presented for each of the twenty-eight variables.

Experimental Design

The data reported in this study were gathered as part of a larger study of communication and adoption of agricultural innovations conducted in the state of Minas Gerais, Brazil, from June, 1966, to January, 1968. (cf. Stanfield, *et al.*, 1968). Designed as a field experiment the study consisted of four separate surveys, two different pretreatments and two experimental communication treatments. The pretreatments were animation and literacy training and the communication treatments were Radio Forums and Community Newspapers. The surveys will be referred to as Phase I, Phase II, Phase 2.5 and Phase III.

The purpose of Phase I was to assess the effectiveness of the Agency for Credit and Rural Assistance (ACAR) in Minas Gerais with a field survey of land owning farmers located within the range of a number of local ACAR offices (equivalent to U.S. extension offices in many respects).

A stratified random sample of 76 communities was drawn and a total of 990 informal and formal community leaders and 38 ACAR agents were interviewed by specially trained university students.

On the basis of aggregate community data derived from the Phase I survey, 18 communities were selected. To meet the restrictions imposed by the communication treatments all communities had to be within the range of a single radio station. All communities had to be relatively accessible, since numerous trips were to be made to each community in the course of the experiments and actual data collection. And finally, in order to avoid taxing the resources of any one local ACAR office, no more than one community was chosen from the area of a single office. This also avoided the possibility that communities would be able to interact with each other while the treatments were proceeding.

One major purpose of the Phase II data collection was to specify the antecedent conditions before the experimental treatments. Therefore, a total of 1,199 interviews with land owning heads of households engaged in agriculture were conducted over a broad range of topics.

Following the Phase II data gathering the eighteen communities were randomly assigned to different pretreatment and treatment groups. The pretreatments were designed to prepare respondents for later communication treatments. In six communities village leaders were exposed to "animation training." In six other communities courses in literacy training were introduced. The remaining six communities served as a control.

To evaluate the effects of pretreatments, 315 respondents from Phase II were reinterviewed nine months after the sessions began (Phase 2.5). While animation produced a few community improvements, literacy training was relatively unsuccessful. Since the pretreatments had few, if any, effects on those variables related to the communication treatments (cf. Stanfield, 1968) they are not included in our analyses.

After the Phase 2.5 data gathering the eighteen communities were subjected to communication treatments. In six communities radio forums were established with the assistance of ACAR agents. In six other communities locally based, mimeographed newspapers were established with the aid of university journalism students. The remaining six communities did not receive any treatments and thus served as a control.

After the communication treatments operated for four months an attempt was made to reinterview all those farmers who had been interviewed in Phase II. The main purpose of Phase III was to measure the impact of the communication treatments. As in any panel study where the individuals are to be reinterviewed, some could not be located, some died, some moved away, and some refused to be interviewed again. The final sample on which this report is based consisted of 1,094 respondents who had been interviewed in both Phase II and Phase III.

Interviewing

The methods used to gather data in Phase II and Phase III were quite similar. A questionnaire was constructed and thoroughly pretested in rural areas. In both cases student interviewers were used; however, in Phase III a special effort was made to secure and train Agricultural College students who presumably had a more profound understanding of rural life than their city-bred counterparts. Four teams of four or five male interviewers per team were formed. About half of the interviewers participated in earlier phases of the study and were well trained in the techniques of interviewing. All interviewers received three days of instruction in personal interviewing and one day of actual practice in a rural community near the training center.

The interviewers were also trained to code and transfer responses to the spaces allotted on the margin of the questionnaire. Once the interviewing began, all coding was completed before the interviewer left the community. Thus, any missing information could be readily acquired without a callback. This method of coding in the field lengthened the total interviewing time but had the advantage of forcing the interviewer to check his own work.

When the coding was finished the team supervisor checked each interview for response and coding error. In addition, each questionnaire was also checked in the project office for illegal codes and interviewing errors. IBM cards were punched directly from the questionnaires in Belo Horizonte. Cleaning revealed very few errors (approximately .001 percent of the punches were in error). Phase II and Phase III together filled fifteen IBM cards per respondent.

Pretreatments and Treatments

The actual practice of animation training was first introduced in Africa (Hapgood, 1964) as a promising method of stimulating change in traditional societies. Essentially, the goal of animation training is to motivate community leaders to attack community problems using community resources. In the Brazil study, participation in the animation training sessions was also expected to influence participation in the later radio farm forums.

Community leaders were chosen from the Phase II data on opinion leadership. Five to eight leaders from each of the six communities were invited to attend a three-day conference on problems facing rural communities. In general, an effort was made to teach the participants how to discuss their common problems and work out self-reliant solutions.

Contrary to expectations, the conference proved to be only the first phase of the animation treatment. Upon returning, the leaders did not, in fact, put their well-laid plans into effect. They merely treated the conference as an interesting exercise with no particular implications for their communities. Subsequent visits by the project staff, however, stimulated some of the leaders to attack community problems. Unfortunately, the training had little or no effect on the later communication treatments.

Literacy training programs were developed and taught by Radiophonic school personnel, a branch of the Minas Gerais Secretary of Education. Tape recorders were used for the main part of each lesson. Special class monitors or the regular community teachers were responsible for playing the program tapes, displaying visual materials, and guiding practice periods following the taped sessions. Classes were usually held every weekday evening.

Due to many difficulties in the execution of the program and the creation of program tapes, the literacy training did not proceed as quickly or smoothly as planned. A detailed study of the program (Herzog, 1967) detected few effects due to these classes, at least over the limited period of time they operated. Participation in literacy training sessions was expected to influence exposure to the planned community newspapers but apparently did not in the limited time period it operated.

In all, the pretreatments were difficult to administer and had few effects on the participants. From their analysis, Stanfield *et al.* (1968) concluded that the pretreatments had *little* value as preparation for large scale communication techniques like radio forums and community newspapers. The changes induced by these treatments seemed to be larger where these pretreatments did *not* exist.

Both radio forums and community newspapers were used previously with some success. The use of radio forums to diffuse agricultural information is based on experience in Canada and India (Neurath, 1962). In this experiment a radio forum consisted of a group of farmers meeting in a rural community to listen to and discuss agricultural information broadcast in a radio program. The size of the group varied from meeting to meeting and across communities with the range usually between four and twenty farmers.

A single radio station broadcast the forum program one evening each week, at an hour when a well-known farm program was regularly scheduled during the rest of the week. The programs, written and taped by a communication specialist from ACAR State headquarters, were devoted to basic information about agricultural innovations and their advantages. Forum groups met during broadcast time, listened to the radio program, discussed the content, and sent any questions that arose to the ACAR headquarters for discussion on later programs. A few problems were encountered, particularly with the weather, which occasionally made travel to and from meetings impossible, and with the radio station, which changed the forum broadcast time several times without informing the staff.

The community newspaper idea originated in Africa but has also been tried in Guatemala, Peru, Brazil and other Latin American countries (Lawrence, 1962). In essence it is a mimeographed newspaper reproduced on the simplest kind of hand operated machine in limited editions of two to three hundred copies. As the name implies, the community newspaper is written, reproduced and distributed entirely on a local basis.

The initial establishment of the newspapers required a good deal of organizational effort. Persons willing to serve as editors had to be located and trained within each community. In addition, journalism students from the Federal University in Belo Horizonte were recruited to go into each community to assist in training and supervision during the first weeks of publication.

Each edition, which appeared concurrently with the radio forum broadcasts, was divided into two parts. One section featured community news: Announcements of weddings and birthdays, appeals for improved roads and telephone service and other happenings of general interest. A second part, written by the same man who created the forum broadcasts, contained information about agricultural innovations identical to the forum broadcasts except for the addition of visuals illustrating the innovation.

Illiteracy was not a large problem, as might have been expected, since most respondents could either read or had someone who could read for them. Editor and audience motivation, however, was difficult to sustain. The long and arduous task of putting out a newspaper placed a great strain on the average editor and community support, although plentiful in the planning stage, waned when it became necessary to provide tangible backing for the paper through subscriptions or advertising.

Because of the many unforseen difficulties, it was nearly impossible to produce sustained use of the forums or the community newspapers. In all, less than 50 farmers who actually attended the forum meetings fell into our sample. Similarly, less than 50 people who read all issues of the newspapers were interviewed. On the other hand, a large number of people reported hearing the forum broadcast or reading one or more issues of the community newspapers. For this reason mere exposure to treatments was ultimately chosen as the treatment variable.

Operational Definitions

The following material was drawn from the English translations of codebooks for the Phase II and Phase III data decks. Most of the items are used directly as measured but several are indices.

ACCESS

a_1 - Cosmopoliteness--respondents were asked how often they visited a large city last year.

a_2 - Social participation--index of total memberships in political, social, religious or agricultural organizations.

a_3 - Literacy--the number of words read correctly in the following sentences: "He who cannot read is like a blind man who has to be guided according to other people's wishes; or then he will stumble his way. The illiterate man is not altogether free--he is the slave of his ignorance. Never stop reading something every day and keep learning."

a_4 - Newspaper community--respondent either lives or does not live in a newspaper community.

a_5 - Radio Forum community--respondent either lives or does not live in a Radio Forum community.

EXPOSURE

b_1 - Purposive radio exposure I--respondents were asked which type of radio program they preferred. Agricultural received a 4, news, a 3, sports a 2, and music a 1.

c_1 - Total print exposure--respondents were asked how many times a month they read (or had someone read for them) newspapers or magazines.

c_2 - Total radio exposure--respondents were asked how often they listened to the radio. Answers were coded: never, almost never, sometimes, more or less one hour/day.

c_3 - Total exposure to ACAR--number of times respondent met ACAR agent in his community or in the city.

d_1 - Purposive newspaper exposure--respondent was asked if he usually received news about agriculture through newspapers.

d_2 - Purposive magazine exposure--respondent was asked if he usually received news about agriculture through magazines.

d_3 - Purposive bulletin exposure--respondent was asked if he usually received news about agriculture through ACAR Bulletins.

d_4 - Purposive radio exposure II--respondent was asked if he usually received news about agriculture through radio.

d_5 - Purposive agent exposure--respondent was asked if he usually received news about agriculture through the ACAR agent.

d_6 - Purposive neighbor exposure--respondent was asked if he usually received news about agriculture through his neighbors.

TRUST

All trust measures are index scores created from the results of all possible paired comparisons between newspaper, radio, ACAR agent, and neighbor. Each person was asked "Whom do you trust most when it comes to new ideas about farming and cattle in general?" for each comparison. The medium chosen received a score of one. Since there were four comparisons for each medium, individual medium scores could range from "0" to "3".

e_1 - Newspaper credibility--number of times newspaper chosen as most trustworthy.

e_2 - Radio credibility--number of times radio chosen as most trustworthy.

e_3 - Agent credibility--number of times agent chosen as most trustworthy.

e_4 - Neighbor credibility--number of times neighbor chosen as most trustworthy.

RECEIVER FACTORS

f_1 - Radio ownership--respondents were asked "Do you have a radio at home?" Answers were coded yes or no.

f_2 - Education--respondents were asked "How many years did you attend school?"

f_3 - Social influence--respondents were asked "Who are three persons in this community who are more listened to or more imitated when it comes to farming and cattle raising in general?" The score on this variable represents the number of times a respondent was mentioned by his fellow farmers.

KNOWLEDGE

The knowledge variable is an index composed of a number of items tapping information about thirteen different practices. The practices were:

Soil Conservation

Trench Silo

Mechanical Planter

Household Pharmacy

Controlled Breeding

Grass Plots

Mineral Salts

Vaccine for Hoof and Mouth Disease

Ant Killer

Termite Killer

Tick Killer

Herbicide

Reforestation

Each of these innovations was described in detail on the forum broadcasts and in the community newspapers. In most cases respondents were asked what an innovation was or how it was used.

ATTITUDES

The attitude variable was also an index composed of a number of items tapping opinions or attitudes toward the thirteen innovations. Farmers were asked for opinions about alternative methods compared to the new innovation or if they would like to adopt such an innovation. In the case where alternatives were given, choice of the new innovation over the alternative was taken as a positive attitude.

ENABLING FACTORS

i_1 - Income is the only enabling factor. Each farmer was asked his approximate income from the previous year.

EXPOSURE TO RADIO FORUM

r_1 - Respondents who reported listening to radio forum broadcasts at least once were placed in one category. All others were non-listeners.

EXPOSURE TO COMMUNITY NEWSPAPER

n_1 - Respondents reported either reading or having someone read at least one issue of a community newspaper. All non-readers were placed in a second category.

CHAPTER IV

RESULTS

Results for the blocked indicator and reciprocal causation models are presented in this chapter. A revised form of the blocked indicator model is developed from initial results and tested and the reciprocal causation model is trimmed of insignificant relationships. The section concludes with a comparison of the two models.

Introduction

As mentioned previously, the applications of path analysis and causal inferences are inhibited by a number of restrictive assumptions. Many of these assumptions are important ones and their violation is usually enough to drastically weaken one's ability to draw valid conclusions from the results of analyses. For this reason, it would be useful to discuss them thoroughly as we proceed through the various stages of our analyses. Unfortunately, the results alone are quite complicated. The repeated evaluation of assumptions at each stage would therefore be very unwieldly.

As a compromise, results are presented with a minimum of discussion. When the blocked indicator model is revised, for example, certain assumptions are evaluated in order to make decisions about new hypothetical relationships.

Similarly, when the reciprocal causation models are evaluated some of the restrictions on the use of least-squares regression will be examined. In general, however, the bulk of such discussion is retained until the discussion section.

Blocked Indicator Model

Multiple-Partials: Formula and Computation

The blocked indicator model illustrated in Figures 3 and 4 of Chapter I is evaluated with first-order and multiple-partial correlation coefficients. The formula for the little used multiple-partial was given by Blalock (1960, p. 350):

$$r_{1(23)\cdot 4}^{2} = \frac{R_{1\cdot 234}^{2} - r_{14}^{2}}{1 - r_{14}^{2}}$$

This formula can be extended to the appropriate number of variables and the resulting coefficients tested for significance using the conventional F-test for the partial correlation. In this case, the appropriate multiple correlations were generated from a standardized statistical program (LS) provided by the Agricultural Experimental Station at Michigan State University. Multiple-partial coefficients were calculated by substituting the proper values in the equation given above.

Significance of Multiple-Partials

While computation of the various statistics to test the blocked indicator model was relatively straight-forward, their evaluation and interpretation presents a serious problem. Several criteria must be adopted to rectify difficulties encountered in the analysis.

Sullivan's empirical example of the use of multiple-partials appeared to work very well but application of the method to the Brazil data revealed three major complications:

1) The use of statistical significance to evaluate assumptions and predictions may only be viable with small samples.

2) Multiple-partial correlations may not work as well when there are larger numbers of variables or variables with high variance.

3) The logic of the Simon-Blalock technique cannot be readily applied to larger numbers of variables once the initial model has been rejected.

Sullivan was not faced with a problem of significance level. His sample consisted of grouped data from 35 states. Thus, his correlations had to reach the range of .3 to .5 to be significant at the .05 or .01 level. In addition to being significant, these correlations were also meaningful in that they explained at least 10 per cent of the variance. In the case of the Brazil data a first-order or multiple-partial correlation with ten indicators that reaches a value of approximately .03 will be significant at the .001 level. Unfortunately, all of our predictions and assumptions are stated in terms of their being equal or not equal to zero. With our huge sample size almost all the results are significantly different from zero.

Practically speaking, a correlation of .03 is conceptually negligible. Some other criteria must be used to decide when to reject a hypothesis. In the absence of any objective standards or conventional criteria a more or less pragmatic criterion would seem to be the most useful. Therefore, in the following tables, any correlations which exceed .2 or .3 will be considered "practically" significant. Correlations of this size represent 5 to 10 per cent of the common variance and thus, while small, are at least not negligible.

Multiple-partials may have worked so well for Sullivan because he used grouped data. He, in fact, was worried that his control variables would wipe out all the variance between his dependent and independent variables. He noted, "one could argue that 'of course, any partial will drop to or near zero if we allow so many variables to first wipe out variation in the dependent variable'." (p. 329). While he recognized this possibility it did not appear to confound his results. Since he was working with averages scores, however, random variance was vastly reduced. In case individual scores are used and random variance is much higher. Hopefully, the variables will <u>not</u> wipe out all the variance between dependent and independent variables.

Cursory examination of the multiple-partials quickly indicates that, despite predictions, they remain quite large. Since it is possible that random variance could account for some of these values, we must introduce another criterion to evaluate hypotheses. The statistic proposed is the percentage reduction in variance produced by removal of the control variables. This is calculated from the following formula:

$$P = \frac{R^2_{1\cdot 234} - R^2_{1(23)\cdot 4}}{R^2_{1\cdot 234}} \times 100\%$$

There is no objective criterion or agreed upon standard for evaluating the significance of this statistic. The value of 90 per cent would seem appropriate: if a control wipes out 90 per cent of the variance held in common between two items or groups of items there is good reason to suspect that it operates as an intervening variable.

Finally, the incisive logic of the Simon-Blalock procedure cannot be used to modify our model if it is disconfirmed by the initial results. There are two reasons for this fact: 1) strong plausible alternative hypotheses are lacking; 2) the basic arithmetic becomes too complicated with so many variables. Sullivan's results supported his model almost completely and he did not have to perform additional manipulations. This is not possible in the present case. Our results are not nearly as clean as Sullivan's and there are few criteria to guide a reformulation.

The best solution to this predicament appears to be a conservative one. Given doubts about the value of a variable in the paradigm, it will be discarded rather than repositioned. Only when a variable is decisively related to other variables--despite predictions--will it be re-evaluated in different positions. This approach is consistent with the logic of the scientific method and should provide the most parsimonious solutions.

Results: Assumptions

The resulting tests of initial assumptions are evaluated first because they are conceptually straightforward and because their significance will modify interpretation of the predictions. Since the absolute quantity of output is quite extensive the results contained in Tables 8 and 9 are also summarized verbally. In all cases, comments refer to the relationships diagrammed in Figures 3 and 4.

Table 8. Results of assumptions for Figure 3 - general model.

	Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
1. $r_{AB} \neq 0$				
(1) $r_{b_1a_1}$ =	.135			
(2) $r_{b_1a_2}$ =	.145			
(3) $r_{b_1a_3}$ =	.153			
(4) $r_{b_1a_4}$ =	.060			
(5) $r_{b_1a_5}$ =	.026			
2. $r_{AC} \neq 0$				
(1) $r_{c_1a_1}$ =	.167			
(2) $r_{c_2a_1}$ =	.072			
(3) $r_{c_3a_1}$ =	.150			
(4) $r_{c_1a_2}$ =	.246	*		
(5) $r_{c_2a_2}$ =	.199			
(6) $r_{c_3a_2}$ =	.344	*	*	
(7) $r_{c_1a_3}$ =	.189			
(8) $r_{c_2a_3}$ =	.216	*		
(9) $r_{c_3a_3}$ =	.166			
(10) $r_{c_1a_4}$ =	-.028			
(11) $r_{c_2a_4}$ =	-.035			

Table 8. cont'd.

		Result	r⩾.2	r⩾.3	% Variance Reduced
(12)	$r_{c_3a_4}$	= -.104			
(13)	$r_{c_1a_5}$	= -.055			
(14)	$r_{c_2a_5}$	= .006			
(15)	$r_{c_3a_5}$	= -.131			
3.	$r_{AD} \neq 0$				
(1)	$r_{a_1d_1}$	= .132			
(2)	$r_{a_2d_1}$	= .286	*		
(3)	$r_{a_3d_1}$	= .260	*		
(4)	$r_{a_4d_1}$	= -.012			
(5)	$r_{a_5d_1}$	= -.059			
(6)	$r_{a_1d_2}$	= .162			
(7)	$r_{a_2d_2}$	= .342	*	*	
(8)	$r_{a_3d_2}$	= .271	*		
(9)	$r_{a_4d_2}$	= -.127			
(10)	$r_{a_5d_2}$	= .065			
(11)	$r_{a_1d_3}$	= .049			
(12)	$r_{a_2d_3}$	= .349	*	*	
(13)	$r_{a_3d_3}$	= .242	*		

Table 8. cont'd.

		Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
(14)	$r_{a_4 d_3}$	= -.038			
(15)	$r_{a_5 d_3}$	= .041			
(16)	$r_{a_1 d_4}$	= .094			
(17)	$r_{a_2 d_4}$	= .179			
(18)	$r_{a_3 d_4}$	= .156			
(19)	$r_{a_4 d_4}$	= -.032			
(20)	$r_{a_5 d_4}$	= -.040			
(21)	$r_{a_1 d_5}$	= .076			
(22)	$r_{a_2 d_5}$	= .316	*	*	
(23)	$r_{a_3 d_5}$	= .223	*		
(24)	$r_{a_4 d_5}$	= -.054			
(25)	$r_{a_5 d_5}$	= .023			
(26)	$r_{a_1 d_6}$	= .007			
(27)	$r_{a_2 d_6}$	= .082			
(28)	$r_{a_3 d_6}$	= .091			
(29)	$r_{a_4 d_6}$	= -.136			
(30)	$r_{a_5 d_6}$	= .011			

Table 8. cont'd.

	Result	r≥.2	r≥.3	% Variance Reduced
4. $r_{BE} \neq 0$				
(1) $r_{b_1e_1}$ =	.146			
(2) $r_{b_1e_2}$ =	.000			
(3) $r_{b_1e_3}$ =	.211	*		
(4) $r_{f_1e_4}$ =	-.043			
5. $r_{GE} \neq 0$				
(1) $r_{c_1e_1}$ =	.050			
(2) $r_{c_2e_1}$ =	.174			
(3) $r_{c_3e_1}$ =	.101			
(4) $r_{c_1e_2}$ =	-.012			
(5) $r_{c_2e_2}$ =	.005			
(6) $r_{c_3e_2}$ =	-.051			
(7) $r_{c_1e_3}$ =	.109			
(8) $r_{c_2e_3}$ =	.232	*		
(9) $r_{c_3e_3}$ =	.195			
(10) $r_{c_1e_4}$ =	-.079			
(11) $r_{c_2e_4}$ =	.081			
(12) $r_{c_3e_4}$ =	-.067			

Table 8. cont'd.

	Result	r⩾.2	r⩾.3	% Variance Reduced
6. $r_{DE} \neq 0$				
(1) $r_{e_1d_1}$ =	.129			
(2) $r_{e_2d_1}$ =	-.017			
(3) $r_{e_3d_1}$ =	.214	*		
(4) $r_{e_4d_1}$ =	-.073			
(5) $r_{e_1d_2}$ =	.180			
(6) $r_{e_2d_2}$ =	.006			
(7) $r_{e_3e_2}$ =	.219	*		
(8) $r_{e_4d_2}$ =	-.096			
(9) $r_{e_1d_3}$ =	.140			
(10) $r_{e_2d_3}$ =	-.035			
(11) $r_{e_3d_3}$ =	.263	*		
(12) $r_{e_4d_3}$ =	-.050			
(13) $r_{e_1d_4}$ =	.136			
(14) $r_{e_2d_4}$ =	.005			
(15) $r_{e_3d_4}$ =	.223	*		
(16) $r_{e_4d_4}$ =	-.127			
(17) $r_{e_1d_5}$ =	.132			

Table 8. cont'd.

		Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
(18)	$r_{e_2d_5}$	= -.032			
(19)	$r_{e_3d_5}$	= .251			
(20)	$r_{e_4d_5}$	= -.065			
(21)	$r_{e_1d_6}$	= .035			
(22)	$r_{e_2d_6}$	= -.020			
(23)	$r_{e_3d_6}$	= .065			
(24)	$r_{e_4d_6}$	= .095			
7.	$r_{CG} \neq 0$				
(1)	$r_{c_1g_1}$	= .342	*	*	
(2)	$r_{c_2g_1}$	= .230	*		
(3)	$r_{c_3g_1}$	= .358	*	*	
8.	$r_{DG} \neq 0$				
(1)	$r_{g_1d_1}$	= .331	*	*	
(2)	$r_{g_1d_2}$	= .391	*	*	
(3)	$r_{g_1d_3}$	= .325	*	*	
(4)	$r_{g_1d_4}$	= .230	*		
(5)	$r_{g_1d_5}$	= .308	*	*	
(6)	$r_{g_1d_6}$	= .093			

Table 8. cont'd.

		Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
9. $r_{GF} \neq 0$					
	(1) $r_{c_1f_1}$ =	.146			
	(2) $r_{c_2f_1}$ =	.482	*	*	
	(3) $r_{c_3f_1}$ =	.161			
	(4) $r_{c_1f_2}$ =	.409	*	*	
	(5) $r_{c_2f_2}$ =	.154			
	(6) $r_{c_3f_1}$ =	.178			
	(7) $r_{c_1f_3}$ =	.152			
	(8) $r_{c_2f_3}$ =	.130			
	(9) $r_{c_3f_3}$ =	.199			
10. $r_{DF} \neq 0$					
	(1) $r_{f_1d_1}$ =	.194			
	(2) $r_{f_2d_1}$ =	.332	*	*	
	(3) $r_{f_3d_1}$ =	.142			
	(4) $r_{f_1d_2}$ =	.198			
	(5) $r_{f_2d_2}$ =	.254	*		
	(6) $r_{f_3d_2}$ =	.227	*		
	(7) $r_{f_1d_3}$ =	.239	*		

Table 8. cont'd.

	Result	r≥.2	r≥.3	% Variance Reduced
(8) $r_{f_2d_3}$ =	.168			
(9) $r_{f_3d_3}$ =	.196			
(10) $r_{f_1d_4}$ =	.369	*	*	
(11) $r_{f_2d_4}$ =	.110			
(12) $r_{f_3d_4}$ =	.152			
(13) $r_{f_1d_5}$ =	.212	*		
(14) $r_{f_2d_5}$ =	.200	*		
(15) $r_{f_3d_5}$ =	.250	*		
(16) $r_{f_1d_6}$ =	-.008			
(17) $r_{f_2d_6}$ =	.104			
(18) $r_{f_3d_6}$ =	.030			
11. $r_{EF} \neq 0$				
(1) $r_{e_1f_1}$ =	.102			
(2) $r_{e_2f_1}$ =	.017			
(3) $r_{e_3f_1}$ =	.170			
(4) $r_{e_4f_1}$ =	-.076			
(5) $r_{e_1f_2}$ =	.094			
(6) $r_{e_2f_2}$ =	-.075			

Table 8. cont'd.

		Result	r≥.2	r≥.3	% Variance Reduced
(7)	$r_{e_3f_2}$ =	.193			
(8)	$r_{e_4f_2}$ =	-.025			
(9)	$r_{e_1f_3}$ =	.070			
(10)	$r_{e_2f_3}$ =	-.057			
(11)	$r_{e_3f_3}$ =	.154			
(12)	$r_{e_4f_3}$ =	-.031			
12. $r_{FG} \neq 0$					
(1)	$r_{f_1g_1}$ =	.290	*		
(2)	$r_{f_2g_1}$ =	.423	*	*	
(3)	$r_{f_3g_1}$ =	.322	*	*	
13. $r_{GH} \neq 0$					
(1)	$r_{g_1h_1}$ =	.878	*	*	
14. $r_{HI} \neq 0$					
(1)	$r_{h_1i_1}$ =	.471	*	*	
15. $r_{EF \cdot C} \neq 0$					
(1)	$r_{e_1(f_1f_2f_3)\cdot(c_1c_2c_3)}$ =	.064			90.0
(2)	$r_{e_2(f_1f_2f_3)\cdot(c_1c_2c_3)}$ =	.089			27.3
(3)	$r_{e_3(f_1f_2f_3)\cdot(c_1c_2c_3)}$ =	.157			7.6

Table 8. cont'd.

	Result	r⩾.2	r⩾.3	% Variance Reduced
(4) $r_{e_4(f_1f_2f_3)\cdot(c_1c_2c_3)}=$	.044			33.3
16. $r_{EF\cdot D} \neq 0$				
(1) $r_{e_1(f_1f_2f_3)\cdot(d_1d_2d_3d_4d_5d_6)}=$	.045			96.0
(2) $r_{e_2(f_1f_2f_3)\cdot(d_1d_2d_3d_4d_5d_6)}=$	.094			25.0
(3) $r_{e_3(f_1f_2f_3)\cdot(d_1d_2d_3d_4d_5d_6)}=$	.116			89.7
(4) $r_{e_4(f_1f_2f_3)\cdot(d_1d_2d_3d_4d_5d_6)}=$	.031			74.4
17. $r_{GF\cdot C} \neq 0$				
(1) $r_{g_1(f_1f_2f_3)\cdot(c_1c_2c_3)}=$	.386			57.1
18. $r_{GF\cdot D} \neq 0$				
(1) $r_{g_1(f_1f_2f_3)\cdot(d_1d_2d_3d_4d_5d_6)}=$	.393			56.0

Table 9. Results of assumptions for Figure 4--experimental treatments.

		Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
1. $r_{AR} \neq 0$					
(1) $r_{a_1 r_1}$	=	-.040			
(2) $r_{a_2 r_1}$	=	.191			
(3) $r_{a_3 r_1}$	=	.022			
(4) $r_{a_4 r_1}$	=	-.130			
(5) $r_{a_5 r_1}$	=	.298	*	*	
2. $r_{AN} \neq 0$					
(1) $r_{a_1 n_1}$	=	.046			
(2) $r_{a_2 n_1}$	=	.041			
(3) $r_{a_3 n_1}$	=	.091			
(4) $r_{a_4 n_1}$	=	.533	*	*	
(5) $r_{a_5 n_1}$	=	-.274	*	*	
3. $r_{ER} \neq 0$					
(1) $r_{r_1 e_1}$	=	.076			
4. $r_{EN} \neq 0$					
(1) $r_{n_1 e_2}$	=	.000			
5. $r_{FR} \neq 0$					
(1) $r_{f_1 r_1}$	=	.097			

Table 9. cont'd.

			Result	r≥.2	r≥.3	% Variance Reduced
	(2) $r_{f_2 r_1}$	=	-.024			
	(3) $r_{f_3 f_1}$	=	.089			
6.	$r_{FN} \neq 0$					
	(1) $r_{f_1 n_1}$	=	.063			
	(2) $r_{f_2 n_1}$	=	.080			
	(3) $r_{f_3 n_1}$	=	.058			
7.	$r_{GR} \neq 0$					
	(1) $r_{g_1 r_1}$	=	.212	*		
8.	$r_{GN} \neq 0$					
	(1) $r_{g_1 n_1}$	=	.056			
9.	$r_{GF \cdot N} \neq 0$					
	(1) $r_{g_1(f_1 f_2 f_3) \cdot n_1}$	=	.520	*	*	4.8
10.	$r_{GF \cdot R} \neq 0$					
	(1) $r_{g_1(f_1 f_2 f_3) \cdot r_1}$	=	.532	*	*	4.7

I. WERE ACCESS FACTORS RELATED TO EXPOSURE?

A. In general, living in an experimental community was unrelated to any exposure variables. Thus, Newspaper Community (a_4) and Radio Forum Community (a_5) will not be mentioned in any of the following discussion.

B. Purposive exposure to radio content (b_1). None of the three remaining access variables explain more than 5 per cent of the variance in this variable.

C. Total exposure ($C_1C_2C_3$). Social participation is related to both total print exposure (C_1) and total agent contact (C_3). Literacy, surprisingly, is related to total radio exposure (C_1).

D. Purposive (usual) exposure ($d_1d_2d_3d_4d_5d_6$). Social participation and literacy are related to usual use of newspapers, magazines, ACAR Bulletins and extension agents. Use of radio and neighbor as usual sources are unrelated to access at the criterian level. Cosmopoliteness is not practically related to any of these exposure variables.

II. Was EXPOSURE related to KNOWLEDGE?

A. Trust in message sources ($e_1e_2e_3e_4$). Of the trust measures, only agent credibility shows substantial relationships with exposure indicators.

Total use of newspapers, total exposure to agent and citing one's neighbor as a usual source of agricultural news are the only items which do not correlate with agent trust at a practical level.

B. Knowledge of innovations (g_1). All exposure items except neighbor as a usual source of agricultural information are related to knowledge of innovations.

III. Were RECEIVER FACTORS related to EXPOSURE FACTORS?

A. Total exposure ($C_1C_2C_3$). Exposure to radio is highly related to radio ownership and exposure to newspapers is highly related to education.

B. Purposive Exposure ($d_1d_2d_3d_4d_5d_6$). Radio ownership was substantially related to bulletin usage, radio usage and agent usage. Education was related to newspaper usage, magazine usage and agent usage. Social influence correlated with magazine usage and agent usage. In general, having the extension agent as a usual source of agricultural information was related to all RECEIVER FACTORS and naming one's neighbor was related to none.

IV. Were RECEIVER FACTORS related to KNOWLEDGE?

A. Trust in message source ($e_1e_2e_3e_4$). None of the trust variables are related to RECEIVER FACTORS at the criterion level.

B. Knowledge of innovations (g_1). ALL RECEIVER FACTORS are related to knowledge of innovations.

V. Was KNOWLEDGE related to ATTITUDE?

A. Knowledge of innovations and attitudes are highly related.

VI. Was ATTITUDE related to INCOME?

A. Attitudes toward innovations and income are highly related.

VII. Were RECEIVER FACTORS related to KNOWLEDGE despite EXPOSURE?

A. Trust in message sources ($e_1e_2e_3e_4$). When the effect of either total exposure or purposive exposure is removed from the relationship between trust items and RECEIVER FACTORS none of the multiple partials meet the criterion level of significance. This could be due to the fact that none of the first order correlations were significant.

B. Knowledge of innovations (g_1). Although removing the effect of exposure from the relationship between knowledge and receiver factors reduces the correlation substantially the correlation remains significant according to the criterion.

VIII. Were EXPERIMENTAL TREATMENTS related to any other FACTORS?

A. In general, exposure to community newspapers or Radio Forum broadcasts was only related to the community in which ACCESS was possible. Exposure to radio forum was also related to knowledge of innovations.

IX. Summary

A. ACCESS FACTORS--Access to experimental treatments was only related to exposure to those treatments. Cosmopoliteness did show a number of weak relationships with exposure variables but none reached the criterion for significance. Social participation and literacy did relate to exposure variables as was assumed.

B. EXPOSURE items--Purposive use of neighbor as a usual source of agricultural information was the only variable consistently unrelated to the other FACTORS in the developmental model.

C. RECEIVER FACTORS--Relationships between RECEIVER FACTORS and other items confirmed most of the assumptions.

D. KNOWLEDGE--With the exception of trust in extension agent the trust items did not relate to other FACTORS as we assumed. Knowledge of innovations was related according to assumptions.

E. ATTITUDES and ENABLING FACTORS--ATTITUDES and income were related to one-another as we assumed.

F. EXPERIMENTAL TREATMENTS--Only exposure to Radio Forum was related to knowledge. All other assumed relationships failed to meet the criterion.

X. On the basis of these results how should we modify the model?

A. ACCESS FACTORS--Cosmopoliteness (a_1) and newspaper community (a_4) can be dropped.

B. EXPOSURE--Purposive radio exposure I is separated from ACCESS FACTORS. Exposure to Radio Forum could be added as an EXPOSURE item--This issue will be raised more fully in the next section. Purposive use of neighbor can be dropped.

C. KNOWLEDGE--All of the trust items except trust in agent can be dropped. Connection with RECEIVER FACTOR can be rejected.

These modifications will be spelled out more clearly in the next section.

Results: Predictions

The difficulties involved in testing our predictions have already been discussed in detail. In this summary of the prediction results from tables 10 and 11, it will become apparent that more modifications must be conceptualized and tested.

Table 10. Results of predictions for Figure 3--general model.

	Result	r≥.2	r≥.3	% Variance Reduced
1. $r_{EA \cdot B} = 0$				
(1) $r_{e_1}(a_1a_2a_3a_4a_5) \cdot b_1 =$	.165			43.7
(2) $r_{e_2}(a_1a_2a_3a_4a_5) \cdot b_1 =$	.089			00.0
(3) $r_{e_3}(a_1a_2a_3a_4a_5) \cdot b_1 =$	.300	*	*	31.8
(4) $r_{e_4}(a_1a_2a_3a_4a_5) \cdot b_1 =$	.118			12.5
2. $r_{EA \cdot C} = 0$				
(1) $r_{e_1}(a_1a_2a_3a_4a_5) \cdot (c_1c_2c_3) =$	.128			69.2
(2) $r_{e_2}(a_1a_2a_3a_4a_5) \cdot (c_1c_2c_3) =$	.083			30.0
(3) $r_{e_3}(a_1a_2a_3a_4a_5) \cdot (c_1c_2c_3) =$	.248	*		55.3
(4) $r_{e_4}(a_1a_2a_3a_4a_5) \cdot (c_1c_2c_3) =$	.104			54.1
3. $e_{EA \cdot D} = 0$				
(1) $r_{e_1}(a_1a_2a_3a_4a_5) \cdot (d_1d_2d_3d_4d_5d_6) =$	.102			82.7
(2) $r_{e_2}(a_1a_2a_3a_4a_5) \cdot (d_1d_2d_3d_4d_5d_6) =$	.089			27.3
(3) $r_{e_3}(a_1a_2a_3a_4a_5) \cdot (d_1d_2d_3d_4d_5d_6) =$	.210	*		73.0
(4) $r_{e_4}(a_1a_2a_3a_4a_5) \cdot (d_1d_2d_3d_4d_5d_6) =$	.095			80.8

Table 10. cont'd.

		Result	r≥.2	r≥.3	% Variance Reduced
4.	$r_{AF} = 0$				
(1)	$r_{a_1f_1}$	= .092			
(2)	$r_{a_1f_2}$	= .207	*		
(3)	$r_{a_1f_3}$	= .161			
(4)	$r_{a_2f_1}$	= .214	*		
(5)	$r_{a_2f_2}$	= .212	*		
(6)	$r_{a_2f_3}$	= .314	*		
(7)	$r_{a_3f_1}$	= .221	*		
(8)	$r_{a_3f_2}$	= .469	*	*	
(9)	$r_{a_3f_3}$	= .182			
(10)	$r_{a_4f_1}$	= -.046			
(11)	$r_{a_4f_2}$	= -.053			
(12)	$r_{a_4f_3}$	= -.024			
(13)	$r_{a_5f_1}$	= .020			
(14)	$r_{a_5f_2}$	= -.007			
(15)	$r_{a_5f_3}$	= -.043			
5.	$r_{GA \cdot C} = 0$				
(1)	$r_{g_1(a_1a_2a_3a_4a_5)\cdot(c_1c_2c_3)} =$	.399	*	*	97.7

Table 10. cont'd.

			Result	r≥.2	r≥.3	% Variance Reduced
9.	$r_{AI} = 0$					
	(1) $r_{a_1 i_1}$	=	.233	*		
	(2) $r_{a_2 i_1}$	=	.370	*	*	
	(3) $r_{a_3 i_1}$	=	.312	*	*	
	(4) $r_{a_4 i_1}$	=	-.077			
	(5) $r_{a_5 i_1}$	=	.029			
10.	$r_{GB} = 0$					
	(1) $r_{g_1 b_1}$	=	.199			
11.	$f_{FB} = 0$					
	(1) $r_{f_1 b_1}$	=	.209	*		
	(2) $r_{f_2 b_1}$	=	.107			
	(3) $r_{f_3 b_1}$	=	.126			
12.	$r_{BH} = 0$					
	(1) $r_{b_1 h_1}$	=	.216	*		
13.	$r_{BI} = 0$					
	(1) $r_{b_1 i_1}$	=	.233	*		
14.	$r_{HC \cdot G} = 0$					
	(1) $r_{h_1 (c_1 c_2 c_3) \cdot (g_1)}$	=	.196			95.1

Table 10. cont'd.

		Result	r≥.2	r≥.3	% Variance Reduced
15.	$r_{CI} = 0$				
	(1) $r_{c_1 i_1}$ =	.300	*	*	
	(2) $r_{c_2 i_2}$ =	.285	*		
	(3) $r_{c_3 i_3}$ =	.258	*		
16.	$r_{HD \cdot G} = 0$				
	(1) $r_{h_1 (d_1 d_2 d_3 d_4 d_5 d_6) \cdot (g_1)}$ =	.209	*		94.4
17.	$r_{DI} = 0$				
	(1) $r_{i_1 d_1}$ =	.352	*	*	
	(2) $r_{i_1 d_2}$ =	.364	*	*	
	(3) $r_{i_1 d_3}$ =	.301	*	*	
	(4) $r_{i_1 d_4}$ =	.281	*		
	(5) $r_{i_1 d_5}$ =	.322	*	*	
	(6) $r_{i_1 d_6}$ =	.154			
18.	$r_{HE} = 0$				
	(1) $r_{h_1 e_1}$ =	.241	*		
	(2) $r_{h_1 e_2}$ =	-.138			
	(3) $r_{h_1 e_3}$ =	.373	*	*	
	(4) $r_{h_1 e_4}$ =	-.078			

Table 10. cont'd.

			Result	$r \geq .2$	$r \geq .3$	% Variance Reduced
19.	$r_{EI} = 0$					
	(1) $r_{i_1 e_1}$	=	.110			
	(2) $r_{i_1 e_2}$	=	-.070			
	(3) $r_{i_1 e_3}$	=	.251	*		
	(4) $r_{i_1 e_4}$	=	-.023			
20.	$r_{HF \cdot G} = 0$					
	(1) $r_{h_1 (f_1 f_2 f_3) \cdot g_1}$	=	.112			98.4
21.	$r_{FI} = 0$					
	(1) $r_{i_1 f_1}$	=	.357	*	*	
	(2) $r_{i_1 f_2}$	=	.339	*	*	
	(3) $r_{i_1 f_3}$	=	.364	*	*	
22.	$r_{GI} = 0$					
	(1) $r_{i_1 g_1}$	=	.457	*	*	

Table 11. Results of predictions for Figure 4--experimental treatments.

	Result	r≥.2	r≥.3	% Variance Reduced
1. $r_{GA \cdot R} = 0$				
(1) $r_{g_1(a_1a_2a_3a_4a_5) \cdot r_1}$ =	.511	*	*	11.8
2. $r_{GA \cdot N} = 0$				
(1) $r_{g_1(a_1a_2a_3a_4a_5) \cdot n_1}$ =	.533	*	*	1.0
3. $r_{GE \cdot R} = 0$				
(1) $r_{g_1e_1 \cdot r_1}$ =	.182			57.1
4. $r_{GE \cdot N} = 0$				
(1) $r_{g_1e_2 \cdot n_1}$ =	.141			13.0
5. $r_{HR \cdot G} = 0$				
(1) $r_{h_1r_1 \cdot g_1}$ =	.112			98.4
6. $r_{HN \cdot G} = 0$				
(1) $r_{h_1n_1 \cdot g_1}$ =	.092			99.0
7. $r_{RI} = 0$				
(1) $r_{r_1i_1}$ =	.032			
8. $r_{NI} = 0$				
(1) $r_{n_1i_1}$ =	.023			

I. Did EXPOSURE intervene between ACCESS FACTORS and KNOWLEDGE?

A. Trust in message sources ($e_1e_2e_3e_4$). The general model predicts that exposure intervenes between ACCESS FACTORS and KNOWLEDGE. The results tend to support this prediction except for trust in the extension agent. Unfortunately, it is impossible to determine if lack of a relationship reflects no relationship between exposure and trust or the actual removal of common variance. Although there was a reduction in variance explained in most cases it was not substantial.

B. Knowledge of innovations (g_1). The removal of variance due to exposure from the relationship between knowledge and access factors did not substantially reduce the correlation.

II. Did EXPOSURE and KNOWLEDGE intervene between ACCESS and ATTITUDES?

A. Yes, along with knowledge of innovations both total and purposeful exposure helped to substantially reduce the correlation between ACCESS FACTORS and ATTITUDES.

III. Were ACCESS FACTORS related to RECEIVER FACTORS or ENABLING FACTORS?

A. RECEIVER FACTORS ($f_1f_2f_3$). Contrary to predictions: cosmopoliteness (a_1) was related to education (f_2);

social participation (a_2) was related to radio ownership (f_1), education and social influence (f_3); and literacy (a_3) was related to radio ownership and education. All three access items were related to income (i_1).

III. Was purposive radio exposure I related to RECEIVER FACTORS, ENABLING FACTORS, knowledge of innovations, or ATTITUDES?

A. Purposive radio exposure I was correlated with radio ownership, income and attitudes but not with knowledge of innovations.

IV. Do any other FACTORS intervene between KNOWLEDGE and ATTITUDES?

A. No, in each case, controlling for knowledge reduced the correlation between ATTITUDE and other items by at least 94 per cent.

V. Are ATTITUDES toward innovations related to trust in message sources?

A. Attitudes are positively related to both trust in radio and trust in extension agent.

VI. Is income related to other factors besides attitudes?

A. Income is substantially related to all exposure variables except purposive exposure to neighbor.

B. Income is substantially related to all RECEIVER FACTORS.

C. Among the trust variables, income is only related to trust in extension agent.

D. Income is strongly related to knowledge of innovations.

VII. Do EXPERIMENTAL TREATMENTS intervene between any FACTORS?

A. No, although controlling for exposure to radio forum does reduce the relationship between trust in radio and knowledge of innovations.

VIII. Summary

A. ACCESS FACTORS--Cosmopoliteness, social participation and literacy are directly related to knowledge of innovations, RECEIVER FACTORS, and income.

B. EXPOSURE--Purposive radio exposure I is not substantially related to knowledge but is correlated with radio ownership and attitudes.

C. ATTITUDES--No other FACTORS intervene between knowledge and ATTITUDES.

D. Income was substantially related to all FACTORS.

IX. On the basis of these results, how can we modify our model?

A. Cosmopoliteness shows a stronger relationship with RECEIVER FACTORS than with ACCESS FACTORS and is directly related to knowledge. Perhaps it would be better conceived as a RECEIVER FACTOR.

B. Income is definitely related to many more variables than predicted. Perhaps it should occupy another position.

Revised Blocked Indicator Model

In general, there are two ways the Blocked Indicator Model can be revised. First, variables which are unrelated as predicted or assumed can be eliminated. Second, variables which show consistent but unpredicted relationships with other FACTORS can be moved to a different position. In this second case one must have an adequate rationale for making such a change since causal priorities are involved. Given the first set of results the following changes are proposed:

ACCESS FACTORS. The two community variables a_4 and a_5 are unrelated to any other variables except exposure to experimental treatments. In turn, only exposure to the radio forum broadcasts was related to knowledge of innovations. For this reason, the forum community and forum exposure variables are retained. Exposure to community newspaper and living in newspaper community will be discarded.

We might also question the position of the Forum exposure variable. Conceptually speaking, it is similar to the other purposive exposure variables and could be parsimoniously grouped with these variables.

Cosmopoliteness (a_1) failed to show the predicted relationships with exposure variables but was related to RECEIVER FACTORS and knowledge of innovations. It was originally hypothesized that cosmopoliteness was a measure of ease of ACCESS to metropolitan centers. The evidence does not support such an interpretation. In this case, we will fall back on the previous conceptualization of cosmopoliteness as an orientation outside one's social system and treat it as a RECEIVER FACTOR. This is not entirely adequate since even as a RECEIVER FACTOR cosmopoliteness should influence exposure (Cf. Rogers, 1960). On the other hand, Salcedo's (1969) analysis of the Phase I Brazil data also failed to show a strong relationship between cosmopoliteness and media exposure.

EXPOSURE. Among the exposure items only the purposive (usual) use of neighbor as a source of agricultural information was unrelated to other variables. For this reason, it can be discarded. Purposive radio exposure I (b_1) failed to relate to ACCESS FACTORS as assumed but it did relate to radio ownership (f_1) and was almost (r=.199) correlated with knowledge of innovations. It will be retained in the revised model only for comparison purposes.

While the total exposure measures ($c_1c_2c_3$) did not relate as strongly as the purposive exposure variables ($d_1d_2d_3d_4d_5$) they showed enough relationships to justify their retention. The stronger interrelationships of purposive exposure (except for radio exposure, d_4) measures with the rest of the model tends to support the position argued in Chapter I. On the other hand, both purposive exposure and knowledge were restricted to agricultural practices while total exposure tapped exposure to all content. Perhaps we biased our test in favor of our predictions.

KNOWLEDGE. Among the four trust variables, only extension agent credibility shows enough relationships to justify retention. The position of this item can also be called into question. Does it really reflect knowledge of the extension agent or is it a predisposition intervening between agent contact and knowledge gain? While strong support for the hypothetical causal sequence is lacking we can at least evaluate the prediction that agent credibility intervenes between agent contact and knowledge of innovations.

RECEIVER FACTORS. These items showed most of the expected relationships except they were also strongly related to ACCESS FACTORS. This raises rather serious conceptual questions which are better left to the discussion section. For the revised model a connection will be drawn between the two FACTORS with a curved line, indicating that the causal direction is indeterminate.

ATTITUDES. The relationship between ATTITUDES and the rest of the model was generally confirmed. Knowledge of innovations appears to intervene between attitudes toward those innovations and all other variables except income. Since the possibility that knowledge does intervene between income and attitudes was not examined one cannot have confidence in this aspect of the general model. It will have to be examined more closely.

ENABLING FACTORS. Income was correlated with most of the variables in the model. This was not predicted and somewhat difficult to explain. It was previously postulated that ENABLING FACTORS would have an indirect effect on EXPOSURE but a direct effect on ATTITUDES and BEHAVIOR. RECEIVER FACTORS were regarded as a manifestation of ENABLING FACTORS. Obviously, the relationship is stronger than originally assumed.

In general, we can modify our model by expanding on the role of ENABLING FACTORS. The revised model, shown in Figure 11, has income with a direct effect upon RECEIVER and ACCESS FACTORS as well as ATTITUDES. This indicates a causal priority: ENABLING FACTORS produce RECEIVER and ACCESS FACTORS. The reasoning is relatively straight forward. In a traditional society, the past, almost by

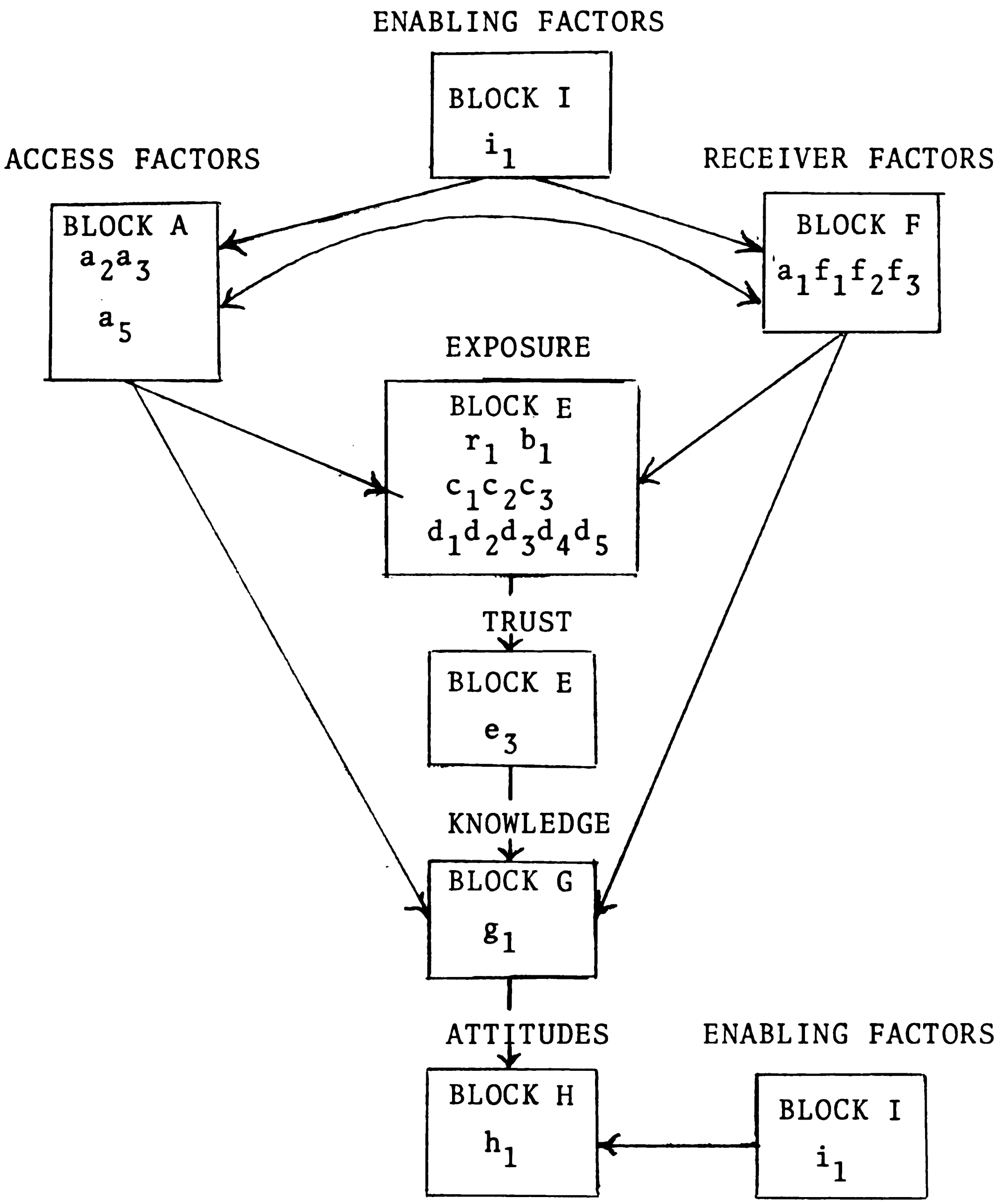


Figure 11. Revised blocked indicator model

Table 12. Results of predictions for Figure 11--revised blocked indicator model.

	Result	r≥.2	r≥.3	% Variance Reduced
1. $r_{IE \cdot AF} = 0$				
(1) $r_{r_1(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.059			97
(2) $r_{b_1(i_1) \cdot (a_2 a_3 a_5 a_2 f_1 f_2 f_3)} =$	.112			85
(3) $r_{c_1(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.130			92
(4) $r_{c_2(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.092			97
(5) $r_{c_3(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.077			96
(6) $r_{d_1(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.187			83
(7) $r_{d_2(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.172			86
(8) $r_{d_3(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.119			92
(9) $r_{d_4(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.127			91
(10) $r_{d_5(i_1) \cdot (a_2 a_3 a_5 a_1 f_1 f_2 f_3)} =$	.139			89

Table 12. cont'd.

		Result	r⩾.2	r⩾.3	% Variance Reduced
2. $r_{IG \cdot AFE} = 0$					
(1) $r_{g_1(i_1) \cdot (AFE)}$	=	.132			96
3. $r_{IH \cdot AFGE} \neq 0$					
(1) $r_{h_1(i) \cdot (AFGE)}$	=	.102			99
4. $r_{g_1(c_3 d_5) \cdot e_3} = 0$					
(1) $r_{g_1(c_3 d_5) \cdot e_3}$	=	.272	*		68

definition has more effect on the present than is true in modern societies. Family income, for example, does not fluctuate as much in a traditional society. It takes generations for a family to rise or a family to fall. This will be reflected in other less grand variables. If a child is born into wealth, he will go to school, become literate, continue his education. His family will travel to the city; they will own a radio. Wealth--a constant wealth--makes all this possible.

Although those with higher income will generally be exposed to more messages, they will not generally be exposed to specific information. Other variables will intervene between income and knowledge and exposure. The revised model postulates that ACCESS and RECEIVER FACTORS are the intervening variables. This can be evaluated, as shown previously, with the use of multiple-partials.

The revised model is shown in Figure 11. Symbolically stated predictions are contained in Table 12. To avoid duplication Table 12 also shows the results and other criterion measures.

Blocked Indicator Model: Final Results

Table 12 results are not difficult to interpret. ACCESS and RECEIVER FACTORS do appear to intervene between income and the other variables. In all cases the correlations between income, exposure, knowledge and attitude variables were substantially reduced by control of the appropriate variables.

It could be argued that removal of so many variables would reduce any correlation substantially. Several checks are available. The first-order correlation between income and radio exposure (r=.285), for example, is reduced by more than half ($r_{12 \cdot 3}$=.137) when one controls for radio ownership. Similarly, the correlation between income and attitude (r=.470) is substantially covered by controlling for knowledge ($r_{12 \cdot 3}$=.162). This does not refute the original argument but it does provide more confidence in the hypothesis that income's effect on exposure, knowledge and attitudes is indirect.

Controlling for the effect of agent trust reduced the correlation between knowledge and exposure to the agent but not enough to indicate an intervening relationship. We will continue to tentatively regard trust as a part of the KNOWLEDGE FACTOR.

The final model is shown in Figure 12. Its implications will be examined in the Discussion section.

Two-Stage Least-Squares Regression

Estimated Values: Computation and Interpretation

Computation of the estimated values for the endogenous variables was relatively straightforward. Beta weights for the eight exogenous predictor variables on each of the 19 endogenous variables were generated with the Agricultural Experimental Station packaged least-squares (LS) routine. The resulting equations with their error terms are shown in Table 14. These equations, without error terms, were placed in a simple computer program and a new deck containing both original and estimated variables was punched out. This was then used as the final input deck for the computation of the final structural equations.

Estimation equations for the two-stage least-squares regression equation are seldom examined or discussed in detail. Brief inspection, however, reveals several interesting details. First, as shown in Table 14 most error terms are

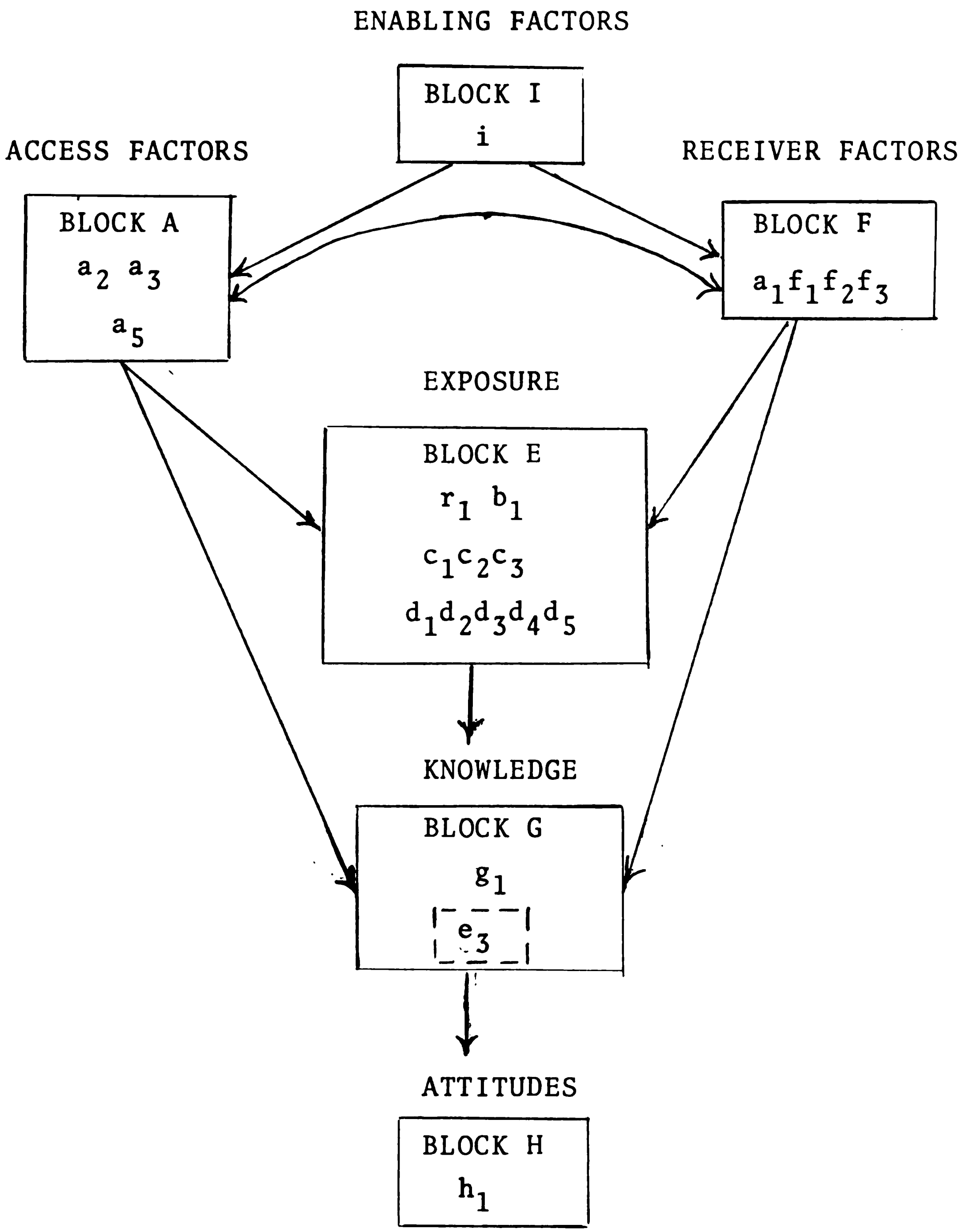


Figure 12. Final blocked indicator model

Table 13. Multiple correlations and zero-order correlations between each exogenous and each endogenous variable.

Exogenous Variables		Print Exposure (y_1)	Endogenous Variables Nsp Usual (y_2)	Mag Usual (y_3)	Bulletin Usual (y_4)	Nsp Trust (y_5)
Literacy	(x_1)	.189	.260	.271	.242	-.067
Education	(x_2)	.409	.332	.254	.168	-.075
Radio Ownership	(x_3)	.146	.194	.198	.239	.017
Cosmopoliteness	(x_4)	.169	.132	.162	.049	-.056
Social Participation	(x_5)	.246	.286	.343	.349	.008
Nsp Community	(x_6)	-.028	-.012	-.127	-.038	.008
Radio Community	(x_7)	-.055	-.059	.065	.041	-.012
Income	(x_8)	.300	.352	.364	.302	-.071
Multiple Correlation		.468	.454	.466	.432	.122

Table 13. cont'd.

Exogenous Variables		Endogenous Variables Social Influence (y_6)	Radio Total (y_7)	Radio Purpose I (y_8)	Radio Purpose II (y_9)	Radio Trust (y_{10})
Literacy	(x_1)	.182	.216	.153	.157	.141
Education	(x_2)	.160	.154	.107	.110	.094
Radio Ownership	(x_3)	.178	.482	.209	.369	.102
Cosmopoliteness	(x_4)	.161	.072	.135	.094	.027
Social Participation	(x_5)	.314	.199	.145	.179	.147
Nsp Community	(x_6)	-.024	-.035	-.060	-.032	-.019
Radio Community	(x_7)	-.043	.006	.026	-.040	.025
Income	(x_8)	.365	.285	.233	.281	.109
Multiple Correlation		.426	.507	.294	.414	.194

Table 13. cont'd.

Exogenous Variables		Agent Usual (y_{11})	Agent Total (y_{12})	Agent Trust (y_{13})	Neighbor Usual (y_{14})	Neighbor Trust (y_{15})
		Endogenous Variables				
Literacy	(x_1)	.223	.166	.250	.091	-.037
Education	(x_2)	.200	.178	.193	.104	-.026
Radio Ownership	(x_3)	.212	.161	.170	-.008	-.016
Cosmopoliteness	(x_4)	.076	.135	.081	.008	-.036
Social Participation	(x_5)	.316	.344	.239	.082	-.073
Nsp Community	(x_6)	-.054	-.104	-.126	-.136	-.070
Radio Community	(x_7)	.023	.131	.068	.011	-.013
Income	(x_8)	.322	.258	.251	.154	-.023
Multiple Correlation		.408	.401	.358	.233	.139

Table 13. cont'd.

Exogenous Variables		Exposure Com Nsp (y_{16})	Exposure Radio Forum (y_{17})	Knowledge (y_{18})	Attitude (y_{19})
			Endogenous Variables		
Literacy	(x_1)	.091	.022	.353	.350
Education	(x_2)	.080	-.024	.423	.372
Radio Ownership	(x_3)	.063	.097	.290	.299
Cosmopoliteness	(x_4)	.046	-.040	.208	.175
Social Participation	(x_5)	.041	.191	.428	.402
Nsp Community	(x_6)	.533	-.131	-.123	-.087
Radio Community	(x_7)	-.274	.298	.132	.139
Income	(x_8)	.023	.032	.457	.471
Multiple Correlation		.552	.368	.619	.599

Table 14. Beta weights for reduced form equations.

1. $y_1 = -1.75^* -0.056x_1 + 0.348x_2^* -0.001x_3 + 0.052x_4 + 0.126x_5^* -0.037x_6 -0.086x_7^* + 0.141x_8^*$

2. $y_2 = -0.051 + 0.063x_1^* + 0.032x_2^* + 0.029x_3 + 0.012x_4 + 0.153x_5^* -0.013x_6 -0.078x_7^* + 0.197x_8^*$

3. $y_3 = -0.031 + 0.115x_1^* + 0.066x_2^* + 0.033x_3 + 0.051x_4 + 0.207x_5^* -0.089x_6^* + 0.002x_7 + 0.198x_8^*$

4. $y_4 = 0.006 + 0.128x_1^* -0.006x_2 + 0.112x_3^* -0.055x_4 + 0.254x_5^* + 0.019x_6 + 0.034x_7 + 0.143x_8^*$

5. $y_5 = 0.740^* -0.042x_1 -0.046x_2 + 0.055x_3 -0.037x_4 + 0.049x_5 -0.002x_6 -0.015x_7 -0.071x_8^*$

6. $y_6 = -0.970^* + 0.046x_1 -0.013x_2 + 0.031x_3 + 0.066x_4^* + 0.196x_5^* -0.031x_6 -0.079x_7^* + 0.255x_8^*$

7. $y_7 = 1.361^* + 0.093x_1^* -0.026x_2 + 0.421x_3^* -0.005x_4 + 0.060x_5^* -0.008x_6 -0.011x_7 + 0.093x_8^*$

8. $y_8 = 1.193^* + 0.074x_1^* -0.031x_2 + 0.133x_3^* + 0.082x_4^* + 0.040x_5 -0.046x_6 -0.007x_7 + 0.135x_8^*$

9. $y_9 = 0.335^* + 0.048x_1 -0.050x_2 + 0.302x_3^* + 0.031x_4 + 0.057x_5 -0.045x_6 -0.077x_7^* + 0.146x_8^*$

* $\beta \neq 0$, two tailed F sig. at $p<.05$.

Table 14. cont'd.

10. $y_{10} = 1.062^* + 0.098x_1^* + 0.012x_2 + 0.048x_3 - 0.017x_4 + 0.106x_5^* + 0.010x_6 + 0.026x_7 + 0.022x_8$

11. $y_{11} = -0.001 + 0.088x_1^* + 0.041x_2 + 0.076x_3^* - 0.027x_4 + 0.207x_5^* - 0.017x_6 - 0.002x_7 + 0.182x_8^*$

12. $y_{12} = -3.216^* + 0.039x_1 + 0.051x_2 + 0.041x_3 + 0.045x_4 + 0.263x_5^* - 0.021x_6 + 0.101x_7 + 0.102x_8^*$

13. $y_{13} = 1.824^* + 0.152x_1^* + 0.037x_2 + 0.053x_3 + 0.001x_4 + 0.136x_5^* - 0.092x_6^* + 0.013x_7 + 0.114x_8^*$

14. $y_{14} = 0.594^* + 0.033x_1 + 0.050x_2 - 0.087x_3^* - 0.031x_4 + 0.028x_5 - 0.161x_6^* - 0.074x_7^* + 0.144x_8^*$

15. $y_{15} = 1.464^* - 0.019x_1 + 0.000x_2 - 0.070x_3^* - 0.019x_4 - 0.066x_5^* - 0.108x_6 - 0.064x_7 + 0.031x_8$

16. $y_{16} = 0.455^* + 0.059x_1^* + 0.064x_2^* + 0.055x_3^* - 0.002x_4 + 0.046x_5 + 0.546x_6^* + 0.005x_7 - 0.011x_8$

17. $y_{17} = -0.076 + 0.022x_1 - 0.059x_2 + 0.082x_3^* - 0.070x_4^* + 0.194x_5^* + 0.043x_6 + 0.310x_7^* - 0.045x_8$

18. $y_{18} = 3.362^* + 0.107x_1^* + 0.221x_2^* + 0.081x_3^* + 0.047x_4 + 0.246x_5^* - 0.020x_6 + 0.102x_7^* + 0.214x_8^*$

19. $y_{19} = 2.486^* + 0.131x_1^* + 0.156x_2^* + 0.094x_3^* + 0.016x_4 + 0.215x_5^* + 0.036x_6 + 0.140x_7^* + 0.259x_8^*$

$^*\beta \neq 0$, two tailed F sig. at $p<0.05$.

statistically significant: these values are assumed to be due to the omission of variables and not to measurement error. Since some of the values are quite large, their deletion will make definite difference in the calculation of the final estimated values. Second, Table 13 gives a better idea of how much variance in the dependent variables is explained by the exogenous items. Prediction is best in the case of knowledge with a multiple correlation coefficient of .619 and worst for newspaper trust (R=.122). Obviously, a great deal is left unexplained. Finally, Table 13 also shows that the exogenous variables are related to the endogenous variables in ways that are not indicated in the structural models. Income (x_8), for example, is strongly correlated with print exposure (y_1). While this will be the subject of further discussion, it is not relevant to the evaluation of the structural models. Only the estimated values are used to test the predictions implied in the structural equations (Cf. Mason and Halter, 1968).

Structural Equations: Results and Interpretation

The use of least-squares regression to evaluate structural models has advantages and disadvantages. One principle advantage is ease of presentation: The equations are brief and to the point; they can easily be presented in diagram form; the beta coefficients can be interpreted in terms of unit change in one variable causing unit change in another variable. These advantages will be demonstrated in the remainder of this chapter and in the Discussion section.

Principle disadvantages include the requirements of uncorrelated error terms and linear relationships. We assume uncorrelated error terms when we use two-stage least-squares regression: Elimination of the error term in the first state wipes out all that variance due to unmeasured variables and reciprocal causation among enodogenous items. The assumption of linearity, however, must be evaluated. In this case all predicted relationships between continous variables were checked for curvilinearity. As usual, Eta was greater than most first-order correlation coefficients. Fortunately, none of the differences were large enough to be statistically or practically significant. If curvilinearily had occurred, it would have been necessary to transform the predictors to achieve a better fit.

Linearity and uncorrelated error terms are only two of the assumptions inhibiting the application of least-squares regression. Because something can be done about them, however, it was useful to discuss them at this point rather than in the following chapter. Unfortunately, they do not help us explain some major discrepancies in the results.

Brief inspection of Table 15 shows that a number of beta weights are negative where theory and the results of the blocked indicator model led us to predict positive values. There is no readily apparent explanation for these numbers. They are not a direct result of the two-stage technique: The simple first-order correlations between estimated and original values are almost uniformly positive. Nor are they an artifact of the statistical computing routine; a variety of standard checks failed to reveal any discrepancies.

If we regard them as valid estimates, then they are a manifestation of the particular partial correlation they represent. In other words, the beta coefficient--which can be treated as a form of partial correlation--appears to show that some of the independent variables operate as "suppressors" of the true relationship between x and y. When their effect is removed, the true relationship is revealed as negative.

Because of the weight of theory and prior evidence, we cannot accept this as a valid explanation for what is ocurring in our model. In equation 2 of Table 15, for example, the relationship between usual exposure to newspapers as a source of agricultural information (y_1), and total exposure (y_1) is negative (β=-1.222) given control for newspaper trust, social influence, literacy and education. Similarly, in equation 3 the relationship between literacy (x_1) and magazine exposure (y_3), after controlling for

Table 15. Final structural equations--reciprocal causation model.

1. $y_1 = 1.379 + 0.189x_1{}^{**}$

2. $y_2 = -0.076 - 1.222\hat{y}_1{}^{*} + 0.622\hat{y}_5{}^{*} + 1.829\hat{y}_6{}^{**}$
$-1.518x_1 + 0.906x_2{}^{*}$

3. $y_3 = -0.065 - 2.893\ \hat{y}_1{}^{**} + 3.130\hat{y}_6{}^{**} - 4.105x_1{}^{**} + 1.619x_2{}^{**}$

4. $y_4 = 1.075 + 0.234\hat{y}_6{}^{**} + 1.036\hat{y}_{11}{}^{*} - 0.901x_1{}^{**} - 0.045x_2$

5. $y_5 = 0.766 - 0.082\hat{y}_2{}^{*}$

6. $y_6 = -0.970 - 5.550\hat{y}_2{}^{*} + 14.954\hat{y}_3 - 12.623\hat{y}_4{}^{*} - 11.025\hat{y}_8$
$2.191\hat{y}_9 + 12.943\hat{y}_{11} - 2.098\hat{y}_{14}{}^{*} - 0.675x_5$

7. $y_7 = 1.52 + 0.482x_3{}^{**}$

8. $y_8 = 1.190 + 0.224\hat{y}_6{}^{**} - 0.028\hat{y}_{10} - 0.021x_2 + 0.152x_3{}^{**}$

9. $y_9 = 0.322 + 0.170\hat{y}_6{}^{**} - 0.012\hat{y}_{10} - 0.038x_2 + 0.328x_3{}^{**}$

10. $y_{10} = 1.128 - 0.309\hat{y}_8{}^{*} + 0.454\hat{y}_9{}^{*}$

11. $y_{11} = 0.015 + 0.468\hat{y}_4 + 0.662\hat{y}_6{}^{*} + 0.381\hat{y}_{12} - 0.976\hat{y}_{13}$
$+ 0.052x_2 - 0.418x_4$

* $\beta \neq 0$, two tailed F sig. at $p<.05$.

** $\beta \neq 0$. two tailed F sig. at $p<.0005$.

Table 15. cont'd.

12. $y_{12} = 7.447 + 0.135\ x_4{}^{**}$

13. $y_{13} = 1.945 + 0.293\hat{y}_{11}{}^{**}$

14. $y_{14} = 0.520 + 0.353\hat{y}_6{}^{**} + 0.279\hat{y}_{15}{}^{**} + 0.026x_5$

15. $y_{15} = 1.164 - 0.016\hat{y}_{14}$

16. $y_{16} = 0.308 + 0.087\hat{y}_2 - .003\hat{y}_6 + 0.007x_1 - 0.003x_5$
$-0.034x_6$

17. $y_{17} = -0.052 - 0.141\hat{y}_6{}^{*} + 0.246\hat{y}_{10} - 0.188\hat{y}_{11}$
$+0.082x_3{}^{*} + 0.225x_5{}^{**} + 0.284x_7{}^{**}$

18. $y_{18} = 44.62 + 1.09\hat{y}_6{}^{**} + 1.281\hat{y}_{11}{}^{*} - 0.184\hat{y}_{16}$
$+ 0.863\hat{y}_{17}{}^{**} + 0.921\hat{y}_{19} - 3.912\hat{y}_{20} + 1.084\hat{y}_{21}{}^{*} + 0.527x_2{}^{**}$

19. $y_{19} = 3.94 + 0.317\hat{y}_{18}{}^{**} + 0.304x_8{}^{**}$

* $\beta \neq 0$, two tailed F sig. at $p<.05$.

** $\beta \neq 0$, two tailed F sig. at $p<.0005$.

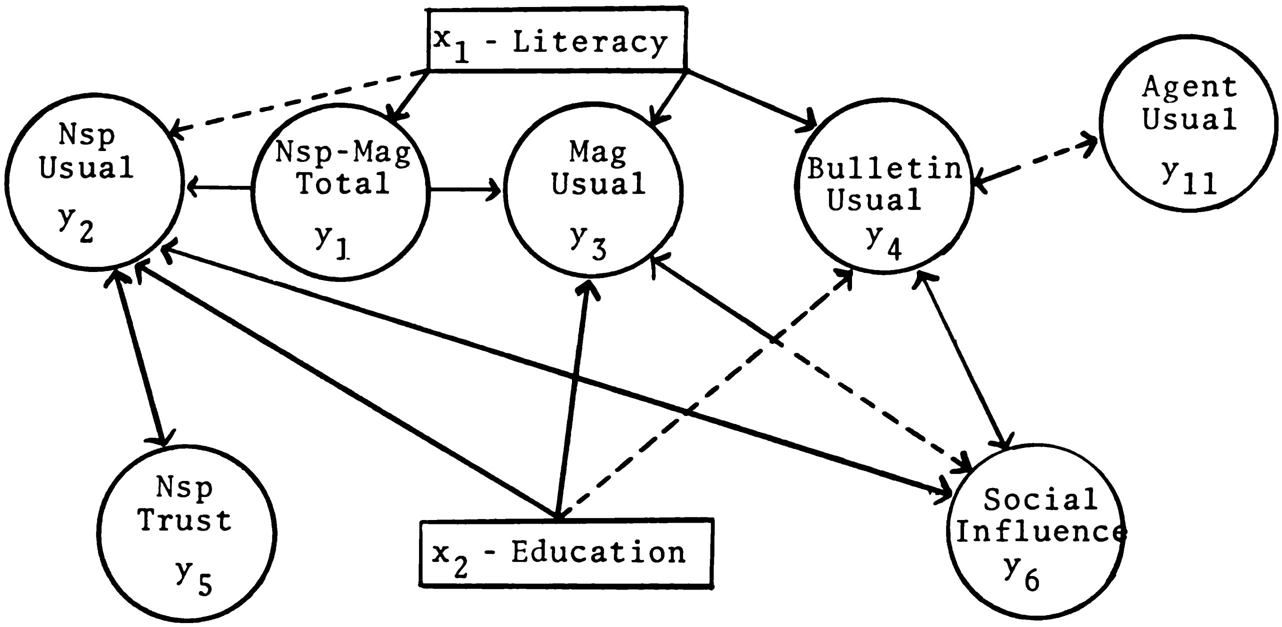
other variables, is strongly negative (β=-4.105,$r_{yx.z}$=-.225). Given the weight of prior experience and simple logic we cannot accept such values. Instead, the assumptions must be reevaluated.

Multicollinearity is the most common reason for unexpected values in multiple correlation problems. In this case, however, it does not seem to be operating. All first-order correlations are relatively small. Curvilinearity is also a possible cause. Here again, the evidence does not support such an explanation. If first-order relationships are linear, then there are few grounds for postulating higher order curvilinearity. To be brief, there are two potential explanations: 1) substantial correlation occurs within the error terms; or 2) there are higher order interaction terms which are biasing our estimates. These are only conceptual distinctions and would be difficult to separate on an operational level. Furthermore, they raise relatively complicated issues that are only appropriate for the Discussion section.

Rather than assume our values are completely unreliable and invalid, we will strike a practical compromise. All significant relationships will be accepted as they stand--regardless of size or sign. However, they will only be discussed as nominal values--either they exist or do not exist. This compromise sacrifices the power of parametric statistics but yields conceptual simplicity. In the remaining paragraphs the diagrams in Figures 13 to 18 are briefly described. A final section compares the results for the two models.

Print exposure. (Figure 13) Disregarding the signs of the beta coefficients, we find that most of the predictions about print exposure were confirmed. The diagram also reveals interesting properties of the use of regression coefficients. For example, while social influence is a relatively good predictor of exposure to magazines, exposure to magazines is not a very good predictor of social influence. In other words, one could conclude that people with social influence tend to read magazines but magazine readers do not necessarily have social influence. Such conclusions must be tempered by the relativity reflected in the partial correlations. The relationship between magazine use as an independent variable and social influence as a dependent variable is attenuated by all the other variables also used to predict social influence. When all the other variables are accommodated by the least-squares technique only newspaper, bulletin and neighbor exposure are strong enough to predict social influence.

Newspaper trust predicts usual use of the newspaper and vice versa. This is in direct contrast to the blocked indicator results and is the only case in the reciprocal causation model where a trust variable is recursively related to an exposure variable.



$$y_1 = f(x_1)$$

$$y_2 = f(y_1, y_5, y_6, x_2)$$

$$y_3 = f(y_1, y_6, x_1, x_2)$$

$$y_4 = f(y_6, y_{11}, x_1)$$

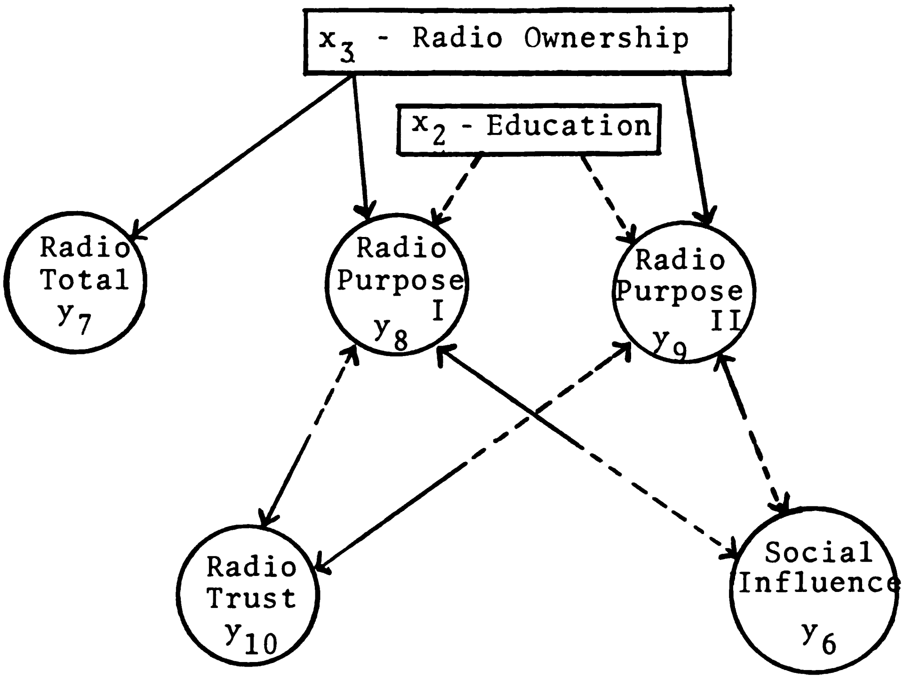
$$y_5 = f(y_2)$$

Key:

——— Predicted and supported

----- Predicted but not supported

Figure 13. Revised reciprocal causation model: print exposure.



$y_7 = f(x_3)$

$y_8 = f(y_6, x_3)$

$y_9 = f(y_6, x_3)$

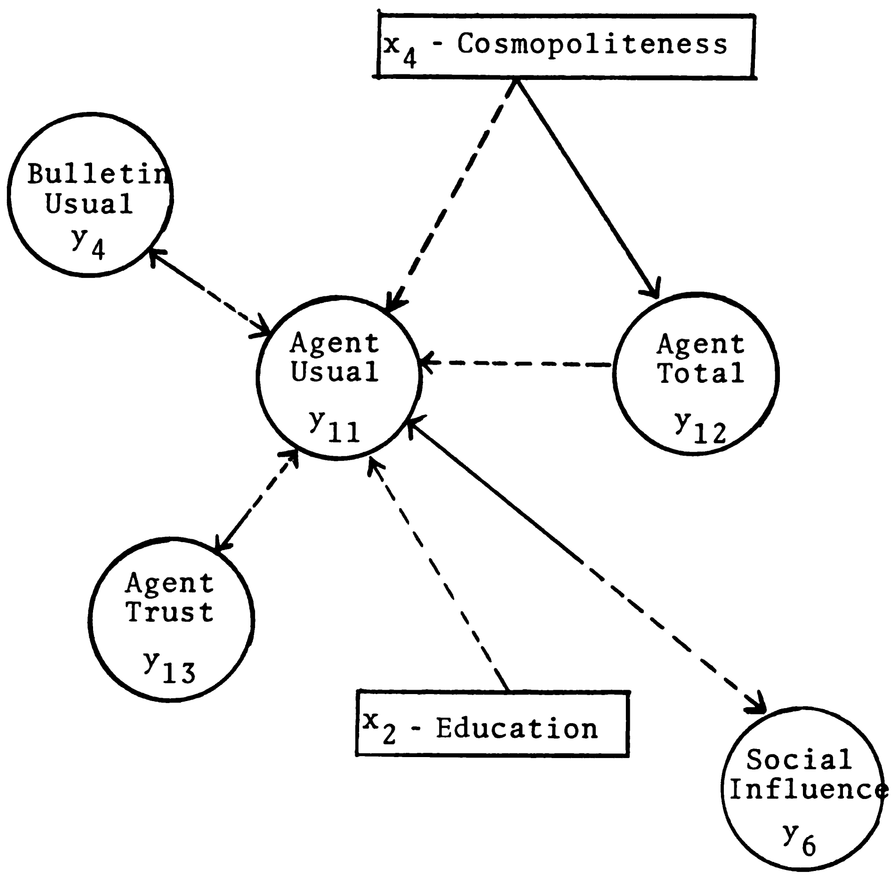
$y_{10} = f(y_8, y_9)$

Key:

——— Predicted and supported

----- Predicted but not supported

Figure 14. Revised reciprocal causation model: radio exposure.



$y_{11} = f(y_6)$

$y_{12} = f(x_4)$

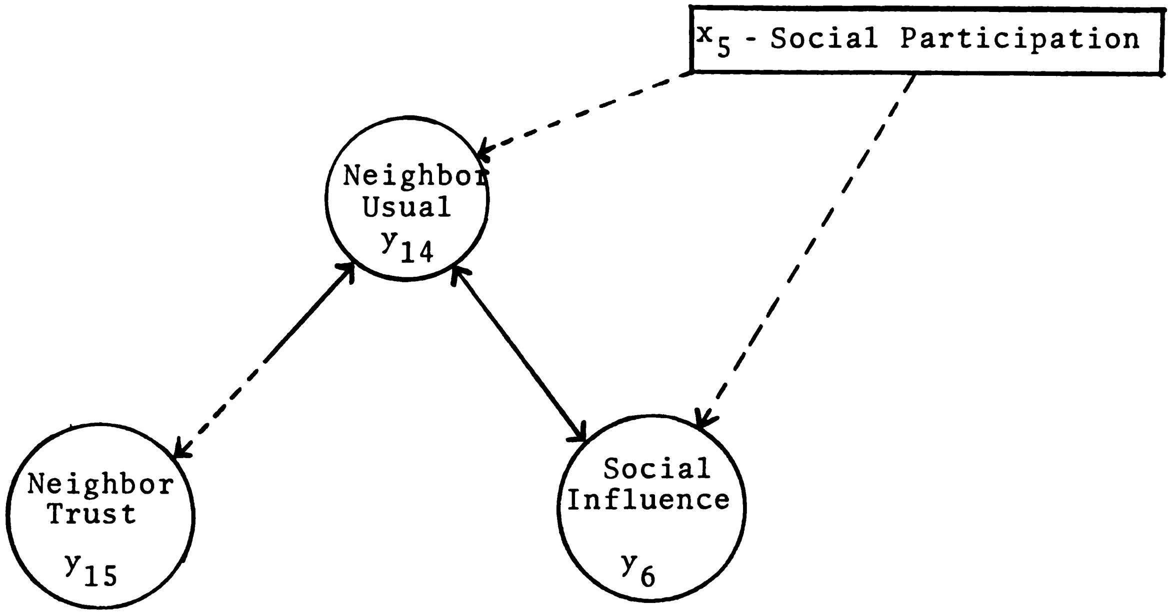
$y_{13} = f(y_{11})$

Key:

——— Predicted and supported

----- Predicted and not supported

Figure 15. Revised reciprocal causation model: agent exposure.



$y_{14} = f(y_6, y_{15})$

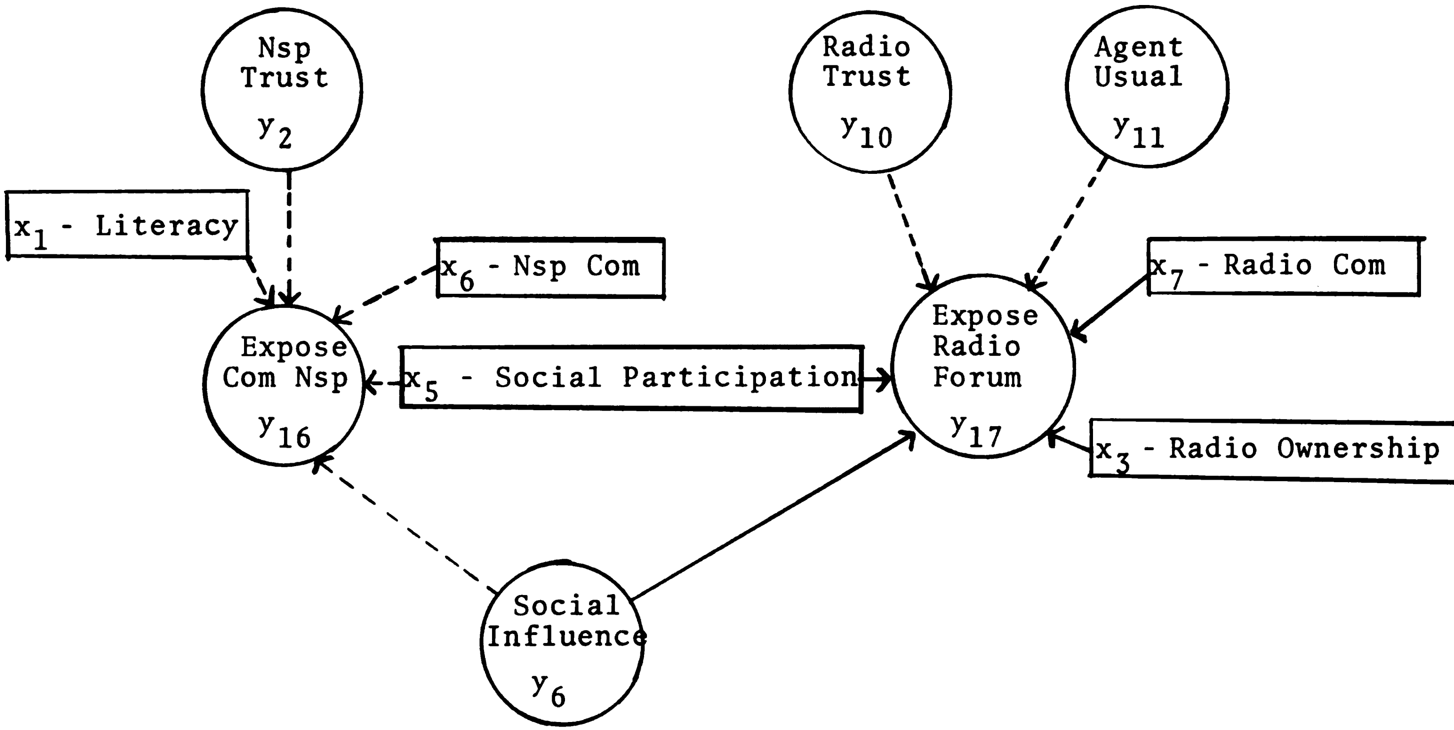
$y_{15} =$

Key:

——— Predicted and supported

----- Predicted but not supported

Figure 16. Revised reciprocal causation model: exposure to neighbor.



y_{16} =

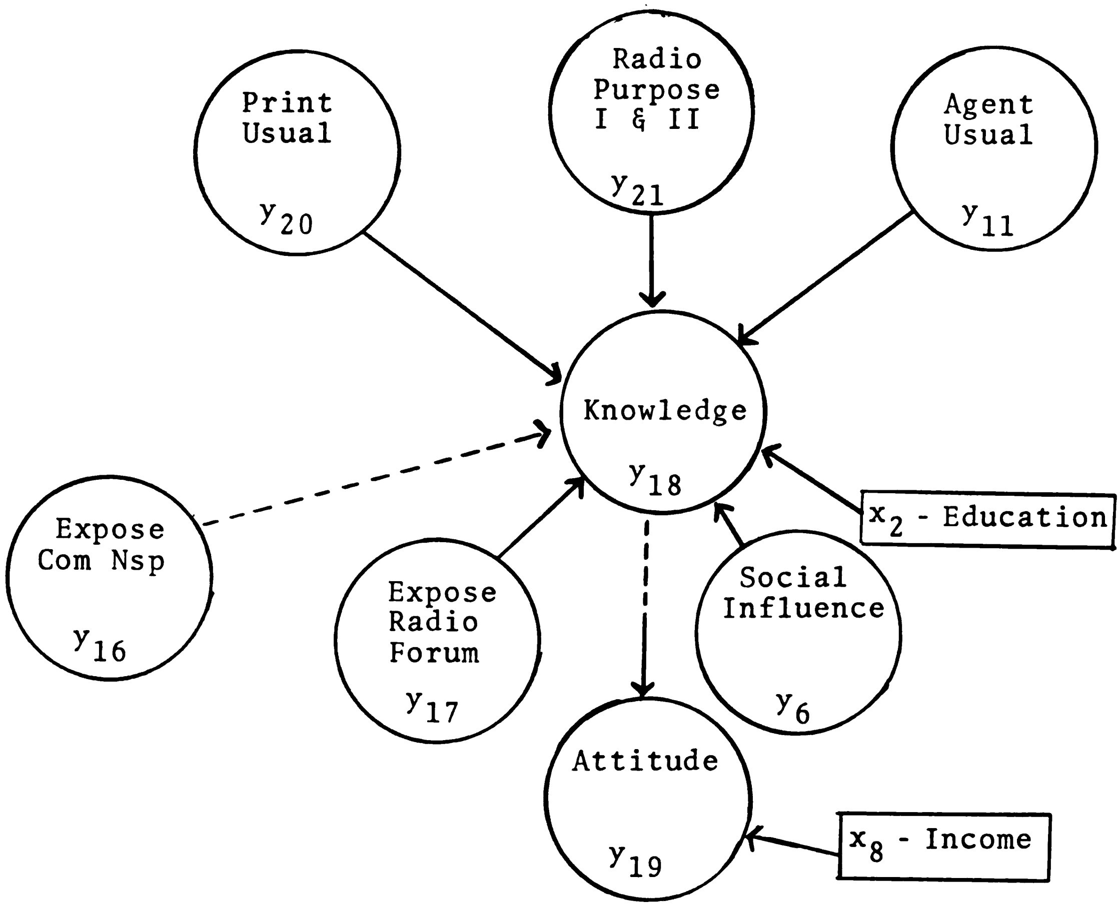
$y_{11} = f(y_6, x_3, x_5, x_7)$

Key:

——— Predicted and supported

- - - - Predicted and not supported

Figure 17. Revised reciprocal causation model: exposure to experimental treatments.



$y_6 \;\; = f(y_2, y_4, y_{14})$

$y_{18} = f(y_6, y_{11}, y_{17}, y_{20}, y_{21})$

$y_{19} = f(y_{18}, x_8)$

Key:

——— Predicted and supported

----- Predicted but not supported

Figure 18. Revised reciprocal causation model: knowledge and attitudes.

Radio exposure. (Figure 14) Radio exposure, unlike magazine or newspaper exposure does not depend on education. In the case of both types of purposive exposure, exposure predicts trust but is not reciprocal. As in the blocked indicator model, radio ownership plays an important role.

Agent exposure. (Figure 15) The agent exposure diagram reveals several interesting relationships. First, only social influence will predict usual exposure to the agent. Total exposure is not related to the usual use of the agent but is correlated with cosmopoliteness. Thus, there is support for the prediction that exposure is effected by access factors. People who travel to the city are exposed to the agent--but do not necessarily cite him as a usual source of agricultural information. This might be taken for support of the proposition that usual users seek the agent outside of their usual trips to the city while those who travel a lot simply come into contact but do not "purposely" expose to the agent. As in the blocked indicator model, the role of agent trust is indeterminate.

Neighbor exposure. (Figure 16) Using one's neighbor as a usual source of agricultural information also shows several interesting effects. First, trusting one's neighbor does tend to predict exposure to the neighbor. Second, social influence and usual use of neighbor are reciprocally related. This could be an artifact since respondents were asked to name someone in their community who they would go to for advice or information. Anyone they picked would stand a good chance of being a neighbor. On the other hand, it could reflect the ACCESS FACTOR: Neighbors are simply closer than others. Finally, it is interesting to note that contrary to the blocked indicator model social participation does not predict either social influence or usual exposure to a neighbor. Other variables are apparently more important in the least-squares solution.

Exposure to experimental treatments. Figure 17 is generally consistent with the blocked indicator model except that several relationships are stronger. Social influence, for example, is related to forum exposure. Brief inspection of Table 15, however, would lead us to express such results cautiously, if at all. The partial correlation, controlling for all other variables is -.09. Still, one can be relatively more confident in the evaluation of the community newspapers. People who exposed to them seem to have been randomly distributed among the population. It is somewhat surprising that even community failed to predict. With the forum broadcasts contact with the agent was not an important factor while group participation was.

Knowledge and Attitudes. (Figure 18) Solution of the least-squares equation for Knowledge presented certain difficulties. In the first place, the original prediction equation was underidentified. This problem was solved by summing the three estimated print exposure variables and the two purposive radio exposure variables into separate indices. This eliminated three of the extra variables. A fourth variable, exposure to neighbor, was deleted because of its generally poor showing in the blocked indicator model.

A second problem was encountered in the computation of the least-squares solution. Often when there are a number of predictors in a regression equation, certain combinations of the independent variables will be found that exactly predict one of the other independent variables. When this occurs it is generally impossible to obtain a unique solution from the least-squares technique. Aside from examining all possible combinations of independent variables predicting the dependent variable the only other solution is to find a "best" solution using an automatic addition--deletion routine. This was done with the knowledge equation. Several different orders of independent variables were submitted under a variety of restrictions. The best solution appears to be one where both exposure to community newspaper and attitudes are insignificantly related to knowledge of innovations. Equation 18 displayed in Table 15 is not a unique solution. Several other equations gave approximately the same results when the variables were entered in a different order.

Again, these results present another problem for interpretation. We know that attitudes and information are highly related (r=.88). The results change, however, when the estimated value for attitude is correlated with the original value for information (r=.46). Apparently, the removal of variance due to other variables and the differences in variance between attitude and information combine to produce a non-significant beta weight. Despite the plausability of this interpretation it is still possible that the "best" solution is merely a statistical artifact.

Tentatively, then, it can be concluded that information will predict attitudes but attitudes will not predict information. Consistent with the blocked indicator model, forum exposure appeared to effect knowledge but community newspapers did not.

Blocked Indicator and Reciprocal Cause: A Comparison

Although there are numerous interpretation problems, it is still possible to compare and contrast the two models. In general, the models yield similar results in most cases where they make similar tests. Because the reciprocal causation model yields more precise connections it helps to specify some of the relationships only broadly indicated in the blocked indicator model.

ACCESS and RECEIVER FACTORS. In general, the blocked indicator model shows that access and receiver variables are related to exposure and knowledge. The reciprocal causation model did not test all the predictions of the blocked indicator model but it does show some of the same relationships after the effects of mutual causation have been removed. Literacy and education are related to print exposure in specific ways but not to radio exposure. Radio ownership predicted total radio exposure, purposive radio exposure and exposure to forum broadcasts. Cosmopoliteness was only related to total agent contact and social participation was only related to radio forum exposure. When corrected for mutual causation the social influence variable predicted most exposure variables and was in turn predicted by three.

EXPOSURE.--The reciprocal causation model revealed some interesting interrelationships among the exposure variables. Because of the limited theory in this area, however, one must be hesitant about ascribing any causal interpretations.

TREATMENTS.--The models were consistent in their results for the experimental treatments. Community newspapers were unsuccessful and radio forums were somewhat successful. Corrected for reciprocal causation the forum variable showed more relationships than it did in the blocked indicator model.

TRUST.--The models contradict one-another with respect to the trust variables. Trust failed to relate as predicted in the blocked indicator model but did show some of the predicted relationships in the reciprocal causation case. These relationships were quite weak and the radio trust item still fails to relate. In sum, the relationship between trust and exposure appears to be slight but significant.

KNOWLEDGE and ATTITUDES.--Predicted relationships were confirmed in both models. The failure of attitudes to predict knowledge in the reciprocal model tends to support the non-recursive assumption of the blocked indicator model.

ENABLING FACTORS.--The basic hypotheses implied by the blocked indicator model were not tested in the reciprocal causation model. This is one of the weaknesses of the reciprocal causation model--it does not alert one to the possibility of alternative positions for our variables.

In summary, there are both similarities and differences in the results of the two tests. The reciprocal causation model allowed more precise statements about the variables effecting information flow in rural Brazil. The blocked indicator model permitted us to test some more general conceptual notions.

CHAPTER V

DISCUSSION

In this chapter results are discussed in detail. Conclusions are drawn about the theoretical, methodological, and social implications of the study and various research extensions are recommended.

Introduction

When any new methodological technique appears in the social sciences it is often abused by investigators who ignore restrictions on its use. This is only somewhat true of path analysis and causal inference because their creators were especially careful to guard against inappropriate application. Blalock (1968 a), in particular, warned of the many possibilities for violating necessary assumptions.

This study was performed in full knowledge of these assumptions. Unfortunately, knowledge alone was not enough to prevent certain discrepancies from appearing in the results. These discrepancies raise strong questions about the basic reliability and validity of the findings and, for this reason, the theoretical and social contributions of this study are somewhat limited. On the other hand, a great deal more is known about the application of the blocked indicator approach and two-stage least-squares regression.

In drawing a set of final conclusions a relatively conservative approach has been adopted. This chapter begins with an evaluation of the various assumptions governing the application of causal path analysis and two-stage least-squares. Questions about reliability and validity are discussed in detail and alternative explanations are assessed. Once degrees of confidence can be applied to the results a set of conclusions are presented. The implications of these conceptual and practical notions are restricted in an effort to avoid adopting conclusions which are not true. Certain theoretical extensions are suggested but for the most part methodological implications are stressed.

Assumptions

Reliability

Although the developmental model was evaluated with multiple-partial correlation coefficients and the reciprocal model was evaluated with regression equations, the factors effecting the reliability of these statistics are approximately the same.

In both cases the statistics require that measurements are made on interval or ratio scales. This is only partly true of the data used in this study. Many of the variables are dichotomous and while one can assume the two points are one interval apart this is not strictly correct. On the other hand, a variety of studies (Bohrnstedt and Carter, 1971) have shown that least-squares regression is quite robust with the use of dummy variables. A weak approximation to intervality should not drastically effect reliability of the results.

The assumption of homoscedasticity is also required. Inspection of the scatter plots for some of the continous variables paired in the reciprocal causation model failed to reveal any extensive departures from this assumption. This does not constitute a complete test by any means; however, it is known (Bohrnstedt and Carter, 1971) that departures from homoscedasticity will affect the significance test but not the actual regression coefficient. Since significance tests were not used for the blocked indicator model homoscedasticity is not relevant to the reliability of these results. The reciprocal causation model did not show any extreme departures and should therefore be relatively free of such bias.

In any multiple regression analysis one must be alert to the problem of multicollinearity. Here, when independent variables are strongly intercorrelated their contribution to the prediction of the dependent variable will be artificially suppressed. This is true of both multiple-partial correlation coefficients and beta weights. It is not a problem anywhere in this study since the only variables which are appreciably intercorrelated are knowledge and attitudes. Since neither of these variables are used as independent variables at the same time, there is no opportunity for multicollinearity to occur. The problem could also occur for the trust items because of the way they were scored. Inspection of the intercorrelations between these items reveals that the values are too low to cause any harm.

As mentioned previously, both models assume that the relationships between items are linear. This possibility was evaluated for the reciprocal causation model and the assumption was supported. Because of the large number of intercorrelations in the developmental model, it would be difficult to check for all possibilities. In general, however, results of the check on the reciprocal model give us some confidence in the developmental model.

Computational errors are always a possibility in any study. When they are random they will affect the reliability of the results and when systematic, they affect both reliability and validity. Most of the results in this experiment were generated by the computer and are highly precise. The results were also checked against a standard to guard against mechanical error. All hand calculations were checked twice. Unfortunately, there is a distinct probability of rounding error within the computer. This is random error but can present serious problems when one is performing a large number of operations in several stages. In particular, the two-stage least-squares regression results are probably only reliable to the second place because of cumulative rounding error. Relatively speaking, this is not a serious problem; however, it cannot be ignored.

Measurement error could have had a serious effect on the reliability of our results. We can not entertain the possibility of systematic errors. Large errors of this nature make it impossible to evaluate one's hypotheses with any reliability or validity. Since there is no reason to suspect such errors and no way of evaluating the model if we did, our concern will be with random error.

Random errors have certain known effects. Such error in the dependent variable will attenuate correlations with the independent variables but will not effect the beta weights. If the independent variables have random error, both statistics will be affected. The degree of bias in the estimate of B_{xy} is a function of the amount of measurement error in X relative to the amouht of actual variation in X. Thus, random error is more serious whenever there is relatively little variation in an independent variable.

Because a number of variables are dichotomous there is a strong possibility many of the correlations and beta weights are relatively distorted by random error. This is also true of the trust variables. Most of the respondents found the extension agent more credible than any other medium. Therefore, in each comparison they chose their extension agent. There is very little variation in the index constructed out of these comparisons. Furthermore, the range of values for the other trust indices was also reduced. We must be careful to temper conclusions where such variables are used as predictors.

In summary, computational errors and random error are suspected of influencing the reliability of our results. This influence should be expecially pronounced among those items with relatively low variability.

Validity

In causal analysis many of the specific procedural steps are based on assumptions which involve basic questions of validity. Several writers (Heiss, 1969; Bohrnstedt and Carter, 1971) examined the effects of weakening these assumptions but failed to arrive at any objective standards for evaluation purposes. In general, there are three assumptions which must be met for a causal analysis to be valid: 1) causal priorities must be undebatable; 2) reciprocal causation is not allowed; 3) there should be no possibility of specification errors. These assumptions are interrelated and apply differently to the blocked indicator and reciprocal causation model.

The requirement of undebatable knowledge of causal priorities is a rigorous one. Only with such knowledge can we set certain coefficients equal to zero and solve equations. Usually this information is only available from a strong theory with good supporting evidence. Such theories are common in biometrics and econometrics but rare in the field of communication.

Any compromise of this assumption opens the way for an erroneous model whose consequences might be worse than ignorance. Why then have social scientists choose such techniques when they lack strong justification for postulating causal priorities? There appear to be two reasons. First, when theory is lacking, time order can be substituted as a partial compromise. If one variable appears before another in time, there is some justification for believing it is a causative factor. Second, model building without full information on causal priorities may be justified as a way of summarizing present knowledge in order to guide future research. Thus, tentative causal models can be regarded as somewhat rigorous heuristic devices.

The question of reciprocal relationships is also related to the requirement of undebatable causal priorities. It has been shown (Blalock, 1971) that lagged values will not produce strong disturbances in a path model. Thus, the requirement of "undebatable" knowledge becomes a question of degree. If one is confident that reciprocal causation occurs only slowly and over long periods of time, then there more justification for postulating a causal path.

One of the objectives of this study was to test the difference between a strict causal path analysis and a causal analysis that allowed for reciprocal causation. The notion of process and feedback have long been core postulates of the field of communication. To what extent were we able to isolate differences due to the two different conceptualizations of the communication process?

First, we must ask if the causal priorities established in our blocked indicator model were undebatable. Then we must question whether the differences in the two models were large enough to be a valid indicator of what really occurred. In the absence of strong theory this becomes a problem of interpretation.

The causal priorities indicated in the hypothetical developmental model can not be rigorously defended on theoretical grounds. To some extent, however, time order is specifiable. It is known, for example, that family income remains relatively constant over long periods of time in traditional societies. Thus there is some justification for postulating that income precedes other factors in the developmental model. We also know that literacy and education must, of necessity, come before exposure and knowledge. These variables do change, but typically they change slowly and can thus be treated as predetermined variables. One has less confidence in assumptions about social influence and social participation. In a traditional society these variables usually change slowly. On the other hand, Stanfield _et al_ (1968) reported several instances where the pretreatments and communication treatments helped propel several people into positions of influence in their communities. If this occured very widely then the assumed time order is incorrect.

The reciprocal model provides a check on these assumptions. If reciprocal causation did occur in the blocked indicator model then the error term would be correlated with the independent variables. This would lead to distortions in the partial correlations. Supposedly, the possibility of such error is eliminated with the two-stage technique and the reciprocal causation model should be free of such error. This was the original impetus for performing the two different analyses. Unfortunately, as the Results chapter and the discussion of reliability indicated, our confidence in exact results must be somewhat attenuated. Therefore, we must fall back once again to subjective judgments.

Principal differences between the two models showed in the relationships of the trust variables to the other items and in the relationship of social influence throughout the model. In the case of the trust items, the possibility of measurement error was large enough to raise strong questions about the reliability of the results. For this reason we must also question the validity of the differences between the two models. There is less reason to suspect unreliability in the relationships between social influence and other variables. Consequently, we will have to regard the absolute causal priority shown in the blocked indicator model as tentative. Implications of this statement will be discussed in later paragraphs.

The possibility of specification errors raises the most serious questions about the validity of the findings. Such errors occur when one mistakenly either includes or omits variables in an equation assumed to capture the true causal path to Y, or when the functional form chosen to represent the variables is incorrect. In general, the problem of spurious correlations and linearity are included under the rubric of specification errors.

Violation of the specification assumption may provide an explanation of the negative beta coefficients. In both models the possibility exists that variables which were the "true" causal variables were left out of the equations. Of course, we can not tell what these variables were. They are disguised in the error term but exert strong influence on the estimates of relationships. Two-stage least-squares removes part of their influence when it only allows the predetermined variables into the

computation of estimated values. Unfortunately, the weights which determine how these variables will operate can still show the influence of outside factors. This means the estimated values could still be in substantial error.

Thus, with two-stage least-squares regression one can eliminate the effect of endogenous interrelationships but one can not eliminate the possibility of specification error. Furthermore, if exogenous factors are related to endogenous factors through third variables we can not totally eliminate the effect of reciprocal causation from the analysis.

Finally, while the possibility of curvilinearity was eliminated we did not account for the possibility of interaction between variables. First and higher order interaction terms that are not specifically included in equations can distort estimates as much as outside factors. With a large number of variables it is extremely difficult to check all first-order interactions. In addition, when they are encountered one should also check for the presence of higher order interactions. If these interactions are found to be significant there arises an interpretation problem: First, are these interactions a chance factor and second, does your theory allow you to interpret them?

In the absence of any better explanation, it is hypothesized that specification errors are responsible for negative beta coefficients in the two-stage least-squares regression. Thus, we acknowledge the probability of bias in the estimators. This bias could have entered in the first stage or the second stage of the analysis. Regardless of where it entered, however, it means that the use of beta weights as parametric estimators is essentially invalid. It does not mean that all inferences from this model are invalid, however. Least-squares regression analysis is robust enough so that any strong relationship should indicate some of the true relationship between variables. For the sake of further discussion, let us assume this is the case.

In summary, major questions can be raised about the validity of the analysis. Specifically, comparison of the developmental model with the reciprocal model revealed that some assumptions of one-way casuation may not be entirely valid. This was especially true for the social influence variable. It was also argued that specification errors probably caused the unexpected negative beta weights. We do not know the extent of this error but have assumed that it is not extensive enough to totally invalidate the findings.

So far the discussion of validity has been restricted to analysis technique. What about those aspects of the experimental situation that could have curtailed our ability to make generalizations to other populations? In particular, do we have any reason to believe that experimental artifacts could have distorted the results?

Field experiments are supposed to have a distinct advantage over laboratory experiments because they enable the experimental treatments to have an effect under natural conditions. To a certain extent this is an advantage. It increases confidence in generalizations. Selective exposure, for example, is allowed to operate as well as a host of other variables that do not ordinarily occur in the typical experiment. Despite these positive features we can not ignore the fact that a large scale field experiment requires a great deal of highly visible organizational activity.

The total Brazil project included four extensive field surveys, pretreatments involving regular meetings and social gatherings and then, finally, rather complex communication treatments. Literally thousands of people were exposed to these activities in one small area of rural Brazil. On the most basic level it meant a lot of strangers riding about in the countryside in AID jeeps. To the distrustful it meant a great increase in government activity. To the bored it meant an interesting topic of conversation. How could this have influenced the results?

For both pretreatments and treatments certain villages were placed in control groups to assess baseline effects. In the case of pretreatments and somewhat in the case of the communication treatments, the control villages showed greater increases than the treatment villages (Stanfield *et al*, 1968). This is one reason to suspect that diffusion of information about the experiment may have paralleled diffusion of information about the agricultural innovations. Tabular information in the original codebooks also shows that many of the respondents knew about the target innovations from other people before they were introduced in the communication treatments. Thus we have reason to suspect the operation of other unmeasured processes in addition to those which were specifically introduced. This decreases our ability to generalize findings to other populations.

Implications and Research Extensions

Implications: The Hypothetical Model

Even though there is some question about the reliability and validity of the analyses, certain statements can be made about the original hypothetical developmental model. ENABLING FACTORS, as operationalized by the income variable, turned out to be a more fundamental causative factor than the original ACCESS FACTOR. We would be relatively more confident in the decision to place this FACTOR as an ultimate predeterminate if there were data on other enabling variables such as race, orientation within the social system and world-view. Speculating very broadly, the position of income in this model seems to give more support to the ideas of Marx than it does to Innis or McLuhan.

The results of the analyses do not support the conceptualization of ACCESS and RECEIVER FACTORS. Cosmopoliteness does not appear to be an ACCESS FACTOR. Social participation, while it is highly related to other items does not seem to reflect the mere presence of social networks. In fact, on second thought it is a poor operationalization of such a variable. Literacy and education do differ but not quite as predicted. All these variables were fairly well measured and we can have some confidence that their relationships to most indicators were fairly reliable if not valid estimates of actual behavior in the Brazil sample.

A factor analysis of the ACCESS and RECEIVER items provides more evidence about their interrelationships. A verimax rotation with the Kiel-Wrigley criterion set at one yielded the three factors shown in Table 16. The first factor is a "social factor" designated by "social influence" and "social participation." The second factor is a "cognitive factor" designated by education and literacy. Radio community defines the third factor. Cosmopoliteness has a rather low loading on Factor 1 and radio ownership has low loadings on both Factor 1 and Factor 2. One might speculate that cosmopoliteness does have a social dimension since it correlated with total agent contact and that radio ownership does reflect, as mentioned previously, something greater than the mere ability to own a radio.

Table 16. Factor loadings of items comprising access and receiver factors.

	FACTOR 1	FACTOR 2	FACTOR 3
Cosmopoliteness	.4193	-.2073	-.1297
Literacy	.1219	-.8182	.0604
Social Influence	.7951	-.0066	.2058
Education	.1182	-.8329	-.0088
Social Participation	.7328	-.1463	-.1037
Radio Ownership	.3611	-.3860	-.0648
Radio Community	.0404	.0340	-.9711
Proportion of variance	.2151	.2254	.1458

These factors do not support the conceptualization of ACCESS and RECEIVER FACTORS. Instead, psychological and social dimensions from each have come together into factors of their own. This does not imply a rejection of the original conceptualization. Two items can be independent of one-another and still indicate a concept. On the other hand, rejection of the ACCESS factor or reformulation might provide a more parsimonious solution.

As a compromise we will conclude that SOCIAL and COGNITIVE FACTORS whose interrelationships are casually indeterminate appear to provide a better interpretation of what was really happening in the Brazil data. Radio community was the only item whose operationalization was close to the meaning intended for ACCESS variables and, hence, the Brazil data could not provide an adequate test of what was meant by such a Factor. The theoretical implications of such COGNITIVE and SOCIAL FACTORS do not appear nearly as heuristic as those of the hypothetical ACCESS and RECEIVER FACTORS.

The results give slight support to the hypotheses about EXPOSURE. To the extent that usual exposure connotes purposive exposure there is some justification for speculation about the difference between casual and passive exposure. Purposive exposure items had generally higher correlations with other items than did total exposure items. This was true even though they had a restricted range which would attenuate relationships. On the other hand, they would be relatively more affected by random error and the fact that most other items were phrased in terms of agricultural information could have introduced a distinct bias.

Purposive radio exposure I, which was based on content preferences, fulfilled some predictions by showing somewhat lower correlations than the "usual" radio item. Again, this conclusion must be tempered by the possibility of measurement error. In all, exposure results imply that people who use the media regularly for information might differ from those who use it for entertainment.

The results do not allow one to draw any firm conclusions about the role of media credibility.

Operationalization of these variables was too poor and their reliability too low to make any concrete statements about their position in the model.

We can draw fairly firm conclusions about the experimental treatments. Community newspapers failed to show much effect at all and exposure to radio forum broadcasts led to fairly small effects. This was consistent with Stanfield *et al* results and will be further discussed under social implications.

The results support the position originally hypothesized for knowledge. The theoretical support for the causal connection between knowledge and attitudes requires further explication before we can have strong confidence in such a finding.

Conceptually then ENABLING FACTORS appear to produce COGNITIVE and SOCIAL FACTORS which may or may not directly cause EXPOSURE. EXPOSURE leads to KNOWLEDGE which in turn causes ATTITUDES.

Research Extensions: The Hypothetical Model

Despite the ambiguity surrounding the test of the hypothetical model a variety of extensions can be recommended. At this point the field of communication appears to be hampered by limited conceptualization. Hence, to improve future research advances will first be required in the area of theory. Certain very fundamental questions must be asked.

To begin with, a broader perspective is required. A general overview of the importance of situational factors to communication behavior is required. Furthermore, we need a much clearer idea of the role of communication technology in historical change. Innis and McLuhan have laid the groundwork in this area but much more needs to be done before concepts and relationships in the region of ACCESS and ENABLING FACTORS can be effectively operationalized.

This can be pursued in at least three different ways. First, wide ranging historical analysis would be a good way to generate large numbers of initial insights. Second, survey research could be used to gain better initial estimates of the interrelationships between ACCESS FACTORS and other variables. Third, laboratory experiments could be designed to explore the cognitive and social ramifications of restricted or open access. Information from these three different approaches could then be used as the foundation for a better articulated causal model than the one explored in this study.

A similar program could be adopted for the investigation of exposure. In particular, measuring instruments could be developed to thoroughly explore the notions of casual, passive and purposive exposure. What is needed most, however, is a sound theory that would at least attempt to explain why selective exposure and patterns of exposure occur. Only when we have a unified notion of these phenomena will it be possible to make systematic scientific progress.

Any comprehensive theory of exposure will have to include concepts similar to source credibility and knowledge. Careful statement of the interrelationships of these three variables would be most useful. Even without an appropriate theory the relationship between media credibility and other communication variables ought to be examined more thoroughly. Does media credibility cause exposure or is it the result of exposure? Can we model the process using lagged values or is reciprocal causation a better hypothesis? This is a site for longitudinal and developmental studies as well as the traditional laboratory experiment.

Many questions should be asked about the social participation and social influence variables before further analyses are attempted. How do people become opinion leaders? Why do they end up as influentials? The use participant observation and laboratory experiments are suggested as ways in which new information about opinion leadership could be gathered. The area has too long been the exclusive domain of survey researchers.

In summary, we can make many suggestions about future conceptual extensions. The problem now becomes one of time and expense rather than imagination.

Implications: Social Practice

Despite original intentions the practical implications of this study are desulatory. The manipulations of the field experiment were found to have very small effects over the time period in which they operated. Hardly enough, in fact, to justify the large capital outlay need for any future implementation. In part this lack of concrete results was due to factors outside the control of investigators. Bad roads restricted access to the Forum meetings; newspaper editor motivation was difficult to maintain. Unfortunately, the final hypothetical model reveals no easy solution to these practical problems. There are many points where one could start to introduce changes. Which is the most important is difficult to say.

We could start at the beginning. ENABLING FACTORS are the primary variables in the model. To change them would be one way to alter the system in a meaningful way. Yet, from experience we know that these are the most difficult variables to change. Changing of ENABLING FACTORS in any radical way is usually called revolution. Moving down the path change becomes a bit easier; yet, the effects will not be so great. It will take a longer time for effects to feedback to ENABLING FACTORS.

Only the potential for improvement offers any hope. If we could refine our measures and clean up our theory at least we could provide information about which decision

would optimize the return for each unit of input. We lack the precision to make such recommendations now. Next time we will know better.

Research Extensions: Social Practice

The Brazil project was an enormous undertaking. Contrary to expectations, however, its main payoff was probably in terms of intangibles. The many lessons learned during the experiment and later in its analysis should have the greatest impact in the future. With this behind us, what should be done improve future research?

We will not attempt to suggest any immediate extensions of the practical aspects of the Brazil Field experiment. The experiment, along with other similar work, was the culmination of many years of theoretical, methodological and practical field work. Many notions were tested that were hitherto unexamined. Much information, unreported here, was used by planners in rural Brazil. Before performing any similar experiment certain basic improvements must be made in research design and implementation.

First, more refined scales should be used to gather information if parametric tests are planned. The power of such techniques will not compensate for bad data. We know that peasant audiences are difficult to interview; however, solutions must be found to these problems. Second, more "situational" variables should be recorded. Condition of roads, availability of bus service, nature of power supply are all easily gathered and could explain at least as much variance as more conceptually sophisticated phenomenological variables. Third, information should be gathered about possible experimenter artifacts. Do the peasants have hypotheses about the behavior of the experimenters? What kind of rumors develop? Finally, someone should be left behind to see what happens after the strangers go away. Subjective or objective analysis of the situation a year after the research has occurred could provide very valuable insights.

The general conceptual notions described in the first chapter and the methods used to operationalize them could also be extended to the developed nations. Many people are speculating about an information revolution in the communication industry. As technological innovations allow the media to become more receiver oriented it will also be possible to measure media use more adequately. Preliminary research on such developmental processes might enable planners to introduce media innovations more appropriately and avoid the rapid dislocations revolutions usually bring.

Implications: Methodology

As mentioned previously, the principle contribution made by this study is methodological in nature. If other communication researchers are going to use blocked indicators or two-stage least-squares regression they will be likely to confront problems encountered in this study. The poor results reported here should not necessarily deter the adoption of these techniques. When used appropriately they will be invaluable tools for both theory construction and testing. In the following paragraphs some general implications of using such methods are derived from the results. Specific recommendations for future use are made in the next section.

In general it is safe to conclude that neither the blocked indicator approach or the two-stage least-squares regression worked as expected. To begin with, there was too little information on the blocked indicator technique: it may not be an adequate method to use with certain kinds of data. This is not to deny its potential power. The multiple indicator approach which it would allow offers great advantages over conventional index construction techniques. The added precision it promises is a strong lure. Finally, the ability to allow any relationships within blocks and causal ones outside is a useful conceptual tool for those with underdeveloped theory.

We can not be as sure in our conclusions about the two-stage least-squares regression technique because we were unable to locate the exact problem. Apparently there was too much error in the data. Predetermined variables may have been intercorrelated. Perhaps they could not produce reliable estimated values. At any rate, inconsistencies prohibited us from taking advantage of the true power of this technique.

Still, the advantages of two-stage least-squares are even more pronounced than those of the blocked indicator approach. Diagrams are useful aids for specifying the meaning of complex interrelationships between variables. More importantly, communication researchers can use such an approach to deal with reciprocal causation: feedback and cybernetic models are open to analysis. For those who advocate the use of computer simulation models two-stage least-squares regression can be used to estimate initial parameters. Finally, the two-stage technique allows one to deal with larger systems of variables than was ever before possible. We have a great deal of evidence that communication behavior is indeed complicated. Such a technique will allow us to model more complicated systems than ever before possible.

Despite their complexity, blocked indicators and two-stage least-squares regression techniques are only sophisticated data processing methods. Their real value is only apparent within the context of path analysis and the logic of causal inference. In this study causal analysis was most important in the initial stages of the problem formulation. It was only in the later stages the true price of using such an approach became evident. Perhaps Heise (1969) summarized the major import of causal analysis when he said:

> . . . path analysis and causal inference procedures involve numerous problems, but this is only because they make explicit so many things that were mostly ignored before. Seeing the problems in analysing cross-sectional data, (investigators) now may turn more attention to the improvement of measurements and to the collection of longitudinal and experimental data as the primary basis for making causal inferences. (p. 70)

Research Extensions: Methodology

The value of causal analysis and causal inferences is most apparent at the conceptualization stage of any project. They aid and guide thinking and are useful regardless of the validity or invalidity of causal connections. In the future, however, the following steps should be taken before applying either the blocked indicator or two-stage least-squares regression techniques:

1. Theory should be advanced enough to define alternative models clearly. In the past communication researchers tended to test only the null hypothesis. In the future it is recommended that they make other, more intricate alternative predictions.

2. The possibility of reciprocal causation should be spelled out in advance. A two-stage least-squares regression will produce different results than a conventional path analysis for several different reasons. If there are theoretical grounds for expecting reciprocal causation then one can have relatively more confidence in such results.

3. Variables should be clear operationalizations of central constructs. This study has shown the difficulty of testing conceptualizations which are awkwardly operationalized.

4. Measurement assumptions should be spelled out in auxiliary theories. The blocked indicator approach allows one to group variables whose causal structure is indeterminate. This approach should not be used without reason, however. Blalock (1971) has recently developed an innovative approach to such measurement problems

5. There should be an adequate number of reliable predetermined variables to avoid underidentification problems and to produce reliable estimated values. In this study several of the predetermined variables were of questionable value; yet, they were necessary because of all the endogenous variables that had to be included. In future studies these variables should be chosen with greater care. One must also be alert to the fact that specification error can occur in these variables as easily as in others.

6. A computer program should be written that would automatically examine the possibility of interaction effects and include such effects where they are significant. This creates an interpretation problem and one must guard against including interactions that could have occured by chance alone. Such a program could also be used to evaluate correlations for curvilinearity.

7. If beta weights are to be used as estimators the reliabilities of each variable should be used to correct for attenuation produced by unreliability. An adequate pretest of the final questionnaire could be used to gather this information.

These steps will not automatically guarantee the proper functioning of either method used in this study. They will, however, enable the careful researcher to at least pinpoint the exact nature of his error.

Epilogue

In the introductory chapter we noted that what communication really needed was a taste of "heuristic reductionism." After all these pages it is difficult to say if this has really occurred. We do pull a lot of variables together into a relatively simple model but our results are surrounded in ambiguity. As the last word only one thing is certain: The state of communication research has yet to wither away.

BIBLIOGRAPHY

BIBLIOGRAPHY

Basmann, R. L. A generalized classical method of linear estimation of coefficients in a structural equation. Econometrica, 1957, 25, 77-84.

Berelson, B. What missing the newspaper means. In P. Lazarsfeld and F. Stanton, (Eds.) Communications Research, 1948-49. New York: Harper, 1949, pp. 111-129.

________, P. F. Lazarsfeld, and W. N. McPhee. Voting: A Study of Opinion Formation in a Presidential Campaign. Chicago: University of Chicago Press, 1954.

Berlyne, D. E. Laughter, humor, and play. In G. Lindzey and E. Aronson (Eds.) The Handbook of Social Psychology, 2nd ed. Reading, Mass.: Addison-Wesley, 1969, 3, pp. 795-852.

Blalock, H. M. Social statistics. New York: McGraw-Hill, 1960.

________. Correlation and Causality: The Multi-variate Case. Social Forces, 1961, 34, 246-251.

________. Causal inferences in non-experimental research. Durham, N.C.: University of North Carolina Press, 1964.

________. The identification problem and theory building: The case of status inconsistency. American Sociological Review, 1966, 31, 52-61.

________. Theory building and causal inferences. In H. M. Blalock and A. B. Blalock (Eds.), Methodology in Social Research. New York: McGraw-Hill, 1968a, pp. 210-240.

________. The measurement problem: A gap between the languages of theory and research. In H. M. Blalock and A. B. Blalock (Eds.) Methodology in Social Research. New York: McGraw-Hill, 1968b, pp. 5-47.

________. Multiple indicators and the causal approach to measurement error. American Journal of Sociology, 1969, 75, 264-272.

________. (Ed.) Causal models in the social sciences. New York: Aldine Atherton, 1971.

Bohrnstedt, G. W. and Carter, T. M. Robustness in regression analysis in H. L. Costner (Ed.) Sociological methodology. San Francisco: Jossey-Bass Inc., 1971, pp. 118-146.

Bondon, R. A method of linear causal analysis: dependence analysis. American Sociological Review, 1965, 30, 365-374.

Campbell, D. T. Social attitudes and other acquired behavioral dispositions. In S. Koch (Ed.) Psychology: a study of a science. New York: McGraw-Hill, 1963, 6, pp. 94-172.

Carlson, E. R. Psychological satisfaction and interest in the news. Journalism Quarterly, 1960, 37, 547-551.

Carter, R. F., and B. S. Greenberg. Newspaper or television: which do you believe? Journalism Quarterly, 1965, 42, 29-34.

________, and O. Sepulveda. Some patterns of mass media use in Santiago de Chile. Journalism Quarterly, 1964, 41, 216-224.

Christ, C. F. Econometric models and methods. New York: John Wiley, 1966.

Collins, B. E. and Raven, B. H. Group structure: Attraction, coalitions, communication, and power. In G. Lindzey and E. Aronson. (Eds.) The Handbook of Social Psychology. 2nd ed. Reading, Mass: Addison-Wesley, 1969, 4, 102-204.

Cooper, E., and H. Dinnerman. Analysis of the film "Don't be a sucker": a study in communication. Public Opinion Quarterly, 1951, 15, 243-264.

Curtis, R. F. and E. F. Jackson. Multiple indicators in survey research. American Journal of Sociology, 1962, 68, 195-204.

De Lawrence, R. T. Rural mimeo newspapers. Paris: UNESCO, Report #46., 1964.

Dervin, B. Information and Attitudes. Unpublished manuscript, 1967.

Deutsch, Karl W. On communication models in the social sciences. Public Opinion Quarterly, 1952, 16, 356-380.

Deutschmann, P. J., and Danielson, W. Diffusion of knowledge of the major news story. Journalism Quarterly, 1960, 37, 345-355.

________. Mass media in an underdeveloped village. Journalism Quarterly, 1963, 40, 27-35.

Duncan, O. D. Path analysis: sociological examples. American Journal of Sociology, 1966, 72, 1-16.

Durlak, J. T. Role circumscription, communication and the modernization process. Unpublished Ph.D. dissertation, Michigan State University, 1969.

Ervin-Tripp, S. M. Sociolinguistics, in L. Berkowitz, (Ed.) Advances in experimental social psychology. New York: Academic Press, 1969, 4, pp. 91-159.

Ezekiel, M. and Fox, K. A. Methods of correlation and regression analysis. New York: Wiley & Sons, 1959.

Farace, R. V. Mass communication, political participation, and other national characteristics: A factor analytic investigation. Paper presented to the Association for Education in Journalism, August, 1965.

Fearing, F. Social impact of the mass media of communication. In N. B. Henry (Ed.), Mass media and education. Chicago: Univ. of Chicago Press, 1954, pp. 165-191.

Fisher, F. M. and A. Andro. Two theorems on Ceteris Paribus in the analysis of dynamic systems. American Political Science Review, 1962, 56, 108-113.

Gough, K. Literacy and social organization. In J. Goody (Ed.) Literacy in Traditional Societies. New York: Cambridge University Press, 1969.

Greenberg, B. S. and H. Kumata. National sample predictors of mass media use. Journalism Quarterly, 1968, 45, 644-648.

________. Diffusion of news of the Kennedy assassination. Public Opinion Quarterly, 1964, 28, 225-232.

________. Media use and believability: some multiple correlates. Journalism Quarterly, 1966, 43, 665-670.

Hapgood, D. Rural animation in Senegal. International Development Review, 1964, 6, 15-18.

Heise, D. R. Problems in path analysis and causal inference in E. F. Borgatta (Ed.) Sociological Methdoology. San Francisco: Jossey-Bass Inc., 1969, pp. 38-73.

Herzog, H. What do we really know about daytime serial listeners? In P. F. Lazarsfeld, and F. N. Stanton (Eds.) Radio Research, 1942-1943. New York: Duell, Sloan and Pearce, 1944.

Herzog, W. A. The effect of literacy training on modernization variables. Unpublished Ph.D. dissertation, Michigan State University, 1967.

Innis, H. A. Empire and Communication, Oxford: Oxford: Oxford University Press, 1950.

________. The bias of communication, Toronto: University of Toronto Press, 1951.

Jones, E. E. and H. B. Gerard. Foundations of social psychology. New York: Wiley, 1967.

Katz, E. and Foulkes, D. On the use of mass media as "escape". Public Opinion Quarterly, 1962, 26, 377-388.

________. The social itinerary of technical change: Two studies on the diffusion of innovation. Human Organization, 1961, 20, 70-82.

Kimball, P. People without papers. Public Opinion Quarterly, 1959, 23, 389-398.

Klapper, J. T. The effects of mass communication. Glenco: The Free Press, 1960.

Kochevar, J. J. The attribution of credibility. Unpublished manuscript, 1971.

Lazarsfeld, P. F., and H. Field. The people look at radio. Chapel Hill: University of North Carolina Press, 1946.

________, and P. Kendall. The communication behavior of the average american. In W. Schramm, (Ed.) Mass Communications 2nd ed., Urbana: University of Illinois Press, 1963, pp. 425-437.

________. The effects of radio on public opinion. In D. Waples (Ed.), Print, radio, and film in a democracy. Chicago: University of Chicago Press, 1942, pp. 66-78.

________. Communication research and the social psychologist. In W. Dennis (Ed.), Current trends in social psychology. Pittsburgh: University of Pittsburgh Press, 1948, pp. 218-273.

Lerner, D. The passing of traditional society: modernizing the middle east. New York: The Free Press of Glencoe, 1958.

Louis, R., and J. Rovan. Television and tele-clubs in rural communities: an experiment in France. Paris: UNESCO, 1955.

McCandless, B. R. A study of non-listeners. In P. F. Lazarsfeld and F. N. Stanton (Eds.), Radio Research 1942-1943. New York: Duell, Sloan, and Pearce, 1944, pp. 407-418.

McClelland, D. C. The Achieving Society. Princeton: Van Nostrand, 1961.

McCrone, D. J., and C. F. Cnudde. Toward a communication theory of democratic political development: A causal model. American Political Science Review, 1967, 61, 72-79.

McGuire, W. J. The nature of attitudes and attitude change. In G. Lindzey and E. Aronson (Eds.) The Handbook of Social Psychology, 2nd ed., Reading, Mass: Addison-Wesley, 1969, 3, pp. 136-314.

McLeod, J. M., S. Ward, and K. Tancill. Alienation and uses of the mass media. Public Opinion Quarterly, 1965, 29, 583-594.

________, R. R. Rush, and K. H. Friederich. The mass media and political information in Quito, Ecuador. Public Opinion Quarterly, 1968, 32, 575-587.

McLuhan, M. The Gutenberg Galaxy. Toronto: University of Toronto Press, 1962.

McNelly, J. T., and P. J. Deutschmann. Media use and socio-economic status in a Latin American capital. _Gazette_, 1963, _9_, 1-15.

Mason, R. _Validity of stages in the adoption process._ Paper presented at the AEJ convention, Eugene, Oregon, 1959.

________, and A. N. Halter. The application of a system of simultaneous equasions to an innovation diffusion model. _Social Forces_, 1968, _47_, 182-195.

Mathur, J. C., and P. Neurath. _An Indian experiment in radio farm forums._ Paris: UNESCO, 1959.

________, and H. P. Saksena. _Social education through television: an all India Radio--UNESCO pilot project._ Paris: UNESCO, 1959.

Merton, R. K. Patterns of influence. In P. F. Lazarsfeld and F. N. Stanton (Eds.), _Communications research 1948-1949._ New York: Harper, pp. 180-219.

Miller, G. H. and McNeill, D. Psycholinguistics. In G. Lindzey and E. Aronson (Eds.) _The Handbook of Social Psychology_, 2nd edition, Reading, Mass: Addison-Wesley, 1969, _3_, pp. 666-794.

Nagel, E. _The structure of science._ New York: Harcourt, Brace & World, 1961.

Neurath, P. N. Radio farm forum as a tool of change in an Indian village. _Economic development and cultural change_, 1962, _10_, 275-283.

Northrop, F. S. C. _The logic of the Sciences and the Humanities._ New York: Macmillan, 1947.

Parker, E. Increasing the audience for educational television. _Audio Visual Communication Review_, 1961, _9_, 99-108.

Pye, L. W. _Communication and political development_, Princeton: Princeton University Press, 1963.

Ramos, E. _Paired comparison analysis of source credibility among peasants._ Working paper #19 (Mimeo), AID diffusion project, Department of Communication, Michigan State University, 1966.

Robinson, W. S. Radio comes to the farmer. In P. F. Lazarsfeld and F. N. Stanton (Eds.), Radio research 1941. New York: Duell, Sloan, and Pearce, 1941, pp. 224-294.

Rogers, E. M. and W. Herzog. Functional literacy among Colombian peasants. Economic Development and Cultural Change, 1966, 14, 190-203.

________, with L. Svenning. Modernization among peasants: The impact of communication. New York: Holt, Rinehart and Winston, Inc., 1969.

________. Diffusion of Innovations, New York: The Free Press, 1962.

________. Mass media exposure and modernization among Columbian peasants. Public Opinion Quarterly, 1965, 29, 614-625.

Rokeach, M. Attitudinal change and behavioral change. Public Opinion Quarterly, 1967, 30, 529-550.

________. Beliefs, attitudes and values. San Francisco: Jossey-Bass, Inc., 1968.

Rosenberg, M. Society and Adolescent Self-Image. Princeton, N.J.: Princeton University Press, 1965.

Salcedo, R. N. A communication model of modernization. Unpublished Ph.D. dissertation, Michigan State University, 1969.

Samuelson, M., R. F. Carter, and L. Ruggels. Education, available time and use of mass media. Journalism Quarterly, 1963, 40, 285-291.

Sargent, L. W. Communicator image and news reception. Journalism Quarterly, 1965, 42, 35-44.

Schramm, W., J. Lyle, and E. B. Parker. Television in the lives of our children. Stanford: Stanford University Press, 1961.

________, and L. Ruggles. How mass media systems grow. In D. Lerner and W. Schramm (Eds.), Communication and change in the developing countries. New York: East-West Center Press, 1967, pp. 57-75.

________. The nature of news. Journalism Quarterly, 1949, 26, 259-269.

Schramm, W. L. The process and effects of mass communication. Urbana, Ill.: University of Illinois Press, 1971.

Simmons, R. E., K. Kent, and V. M. Mishra. Media and developmental news in slums of Ecuador and India. Journalism Quarterly, 1968, 45, 698-705.

Simon, H. A. Spurious correlation: a causal interpretation. Journal of the American Statistical Association, 1954, 49, 467-479.

Stanfield, J. D. et al. Communication in Brazil: experiments in introducing change. Diffusion of Innovation research report #14 (Mimeo), Department of Communication, Michigan State University, 1968.

Sullivan, J. L. Multiple indicators and complex causal models. in H. M. Blalock (Ed.) Causal models in the social sciences. New York: Aldine Atherton, 1971, 327-334.

Theil, H. Estimation and Simultaneous Correlation in Complete Equation Systems. The Hague: Central Plan Bureau, 1953.

UNESCO. Radio broadcasting serves rural development. Paris: UNESCO, 1965.

________. Rural television in Japan. Paris: UNESCO, 1960.

Waisanen, F. B. Education and participation in development: a comparative study in the social psychology of modernization. Paper presented at annual meetings of the American Association for the Advancement of Science, Dallas Texas, 1968.

Webb, E. J., D. T. Campbell, R. D. Schwartz, and L. Sechrest. Unobtrusive measures. Chicago: Rand McNally, 1966.

Weiss, W. Effects of the Mass Media of Communication. In G. Lindzey and E. Aronson (Eds.) The Handbook of Social Psychology, Reading, Mass.: Addison-Wesley, 2nd Edition, 1969, 5, pp. 77-195.

Westley, B. H., and L. C. Barron. An investigation of news-seeking behavior. Journalism Quarterly, 1959, 36, 431-438.

________, and W. J. Severin. Some correlates of media credibility. Journalism Quarterly, 1964, 41, 325-335.

White, W. J. Toward the validation of a functional model of the adoption-rejection process. Unpublished Ph.D. dissertation, Michigan State University, 1967.

Wiggins, J. A. Hypothesis validity and experimental laboratory methods. In H. M. Blalock and A. B. Blalock (Eds.) Methodology in Social Research. New York: McGraw-Hill, 1968.

Wright, C. R. Mass Communication: A sociological perspective. New York: Random House, 1959.

Wright, S. Path coefficients and path regressions: alternatives or complementary concepts? Biometrics, 1960, 16, 189-202.