COMMUNICATION INTEGRATION IN MODERN AND TRADITIONAL SOCIAL SYSTEMS: A COMPARATIVE ANALYSIS ACROSS TWENTY COMMUNITIES OF MINAS GERAIS, BRAZIL

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

LYTTON LEITE GUIMARAES

1972

This is to certify that the

thesis entitled

COMMUNICATION INTEGRATION IN MODERN
AND TRADITIONAL SOCIAL SYSTEMS
A Comparative Analysis Across Twenty
Communities of Minas Gerais, Brazil

presented by

Lytton L. Guimaraes

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Communication

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Date 5/15/72

O-7639

ABSTRACT

COMMUNICATION INTEGRATION IN MODERN AND TRADITIONAL SOCIAL SYSTEMS: A COMPARATIVE ANALYSIS ACROSS TWENTY COMMUNITIES OF MINAS GERAIS, BRAZIL

By

Lytton L. Guimaraes

The central focus of the present study was on communication integration, defined as the degree to which the subsystems, subgroups, and individual units of a communication system are structurally interconnected via interpersonal channels. Communication integration was measured through sociometric choices given by respondents in twenty Brazilian communities, on a criterion concerned with informal friendship.

Drawing on matrix algebra and graph theory, a computer program was utilized to process the sociometric data obtained. This program provides an index of communication integration for each community, which is derived from the relative integration of each individual in the communication network.

A conceptual scheme, derived mainly from general systems theory, was used to analyze the relationships of

communication integration with selected intra-system and extra-system modernization variables in the twenty Brazilian communities. Modernization, defined as the impact upon relatively traditional social systems, of exogenous inputs originating in relatively more modern social systems, was measured in terms of innovativeness, defined as the degree to which an individual adopts new ideas relatively earlier than others in his social system.

The data support the hypothesis that communication integration and innovativeness are positively related. Communication integration was regarded as a linking element between intra-system and extra-system variables, and innovativeness.

Results of the study show that none of the intra-system variables (e.g., interpersonal trust, social participation, opinion leadership concentration) contribute significantly to communication integration, or vice-versa. Most of the extra-system variables (e.g., mass media exposure, external contacts, change agents contacts) do contribute significantly for the integration of the communication system, or vice-versa.

On the basis of these findings, a model is suggested according to which a system's internal inputs are "weakly" related to communication integration and modernization, whereas its external inputs are "strongly" related to these same variables. One question arises, however, as to whether "high" external inputs and "high" communication integration alone are sufficient conditions for a system to "modernize." Certain intrinsic characteristics of the system seem to be directly related to its degree of communication integration, and hence, modernization. Communication, as the information processing subsystem of the social system, would function as a mediating factor in the process of social change. When this mediating factor is "integrated," and the receiving system is open and capable of reorganization, it is more likely that the system will tend toward modernization.

Comparative analysis of the measuring techniques used in the present study; the development of theoretical distributions for n-size communication matrices; and further use of the computer routine utilized in the present study, as well as the analytical procedures it implies, are some of the methodological problems suggested for further research.

Additional studies of the relationships between intra-system and extra-system variables, and communication integration; individual level analysis, combined with aggregate level; analysis of communication networks other than friendship-based (e.g., information seeking); and the relationship of communication integration with other types of integration (e.g., normative, functional), are examples of substantive areas suggested for future research.

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirement
for the degree of

DOCTOR OF PHILOSOPHY

Department of Communication

1972

Accepted by the faculty of the Department of Communication, College of Communication Arts, Michigan State University, in partial fulfillment of the requirements for the Doctor of Philosophy degree.

Director of Thesis

Guidance Committee: ____________, Chairman

ACKNOWLEDGMENTS

I want to express my gratitude to all those persons who made this dissertation possible. Special thanks are extended to the members of my doctoral committee. Dr. Richard V. Farace, committee chairman and director of the present thesis, helped immeasurably with encouragement and suggestions. Dr. Everett M. Rogers, who served as my academic advisor and committee chairman until the time of his sabbatical leave, and later as committee member, was extremely helpful for his friendship, intellectual stimulation, and constructive criticisms. Dr. William Herzog, Dr. Allan J. Beegle, and Dr. Hideya Kumata also made valuable contributions at various stages of this dissertation.

I have a special debt of thanks to my fellow Brazilians, Gilvandro Raposo and Gustavo Quesada, and to Luis Ramiro Beltran, for their friendship and encouragement during our graduate studies at Michigan State University.

My wife, Christine, helped wholeheartedly at different stages of this study. She, and our children, Viveka, Margit, and Nicole, gave me much needed support. I dedicated this dissertation to them and my parents.

TABLE OF CONTENTS

LIST OF TABLES

Table | Page

LIST OF FIGURES

CHAPTER I

THE PROBLEM IN ITS CONTEXT

Introduction

The problem of social integration has long been a subject of interest to social scientists. Auguste Comte, Herbert Spencer, and many other students of social phenomena dealt directly or indirectly with the problem of fitting smaller units into larger wholes.

Social integration has been studied at many different levels, and from various perspectives--from the individual level to societal and cultural levels, and from the psychological and psychiatric points of view to sociological and cultural perspectives. A collection of readings on integration (Zawodny, 1966) includes some twenty selections that deal with the problems of individual integration, some thirty-two that focus on interpersonal and group integration, and over forty other articles that deal with various aspects of nation-states integration.

The exploration of such a complex phenomenon as integration seems more fruitful if broken up into subtypes, so that each subdivision may be treated as a variable for research. Landecker (1951) goes even further when he points out that we do not know enough about social integration to postulate any one set of data as the index of integration as such. Instead, he suggests that social integration should be studied in terms of four basic dimensions:

1. Cultural integration, defined as the degree to which cultural standards are mutually consistent in a given social system.

2. Normative integration, defined as the extent to which the conduct of members of a social system conforms to the system's norms.

3. Functional integration, defined as the degree to which there is mutual interdependence among the units of a system of division of labor.

4. Communicative integration, defined as integration among persons in the sense of an exchange of meanings.

Each of these four dimensions of social integration, says Landecker, varies along a continuum of its own, ranging from one theoretical extreme to the other. Also, each type raises its own problems of measurement and analysis.

Most studies of cultural integration come from cultural anthropological field work carried out in relatively traditional social systems. The work of scholars like Ralph Linton and Ruth Benedict has shown that "cultures are configurations which vary in internal consistency or integration." But while the concept of cultural integration is widely used, it has not received a sufficiently and quantifiable definition for purposes of research (Landecker, 1951).

Parsons (1937, 1951, 1960) deals extensively with the problem of normative integration, but only from a theoretical position. Little empirical research has been done on the concept, with the result that there is little theory relating it to other aspects of the social system (Angell, 1968).

The notion of functional integration permeates Durkheim's (1960) work and is also closely associated with the functionalist school in anthropology and sociology. Merton (1957), for instance, takes the position that each part of a social system may make functional as well as dysfunctional contributions. For example, a new industrial plant may be functional to a community, from the economist's point of view, since the plant is expected to create new jobs and bring other economic benefits to the community. From a conservationist's point of view, however, the new plant may be dysfunctional to the community. The conservationist may see the plant as a potential source of pollution.

Modern ecology is also particularly concerned with the problem of functional integration. Measurement, however, remains a crucial issue, especially because interdependence (of the units in a system of division of labor) is a multidimensional phenomenon.

Purpose of the Study

Our main concern in the present study is with communicative, or communication, integration, which we define somewhat differently from Landecker (1951). For our purposes, communication integration refers to the degree to which the subsystems, subgroups, or individuals in a communication system are structurally interlinked, via interpersonal channels.

To understand more clearly the concept of communication integration, we also need to define the term structure. Structure, for our present context, refers to the system of roles occupied by individuals in a communication system, such as that of a community. The communication structure of a communication system consists of the networks of interpersonal relationships among its role occupants. A system with relatively "high" communication integration would be one where a relatively large proportion of members--persons occupying roles and role systems--maintain a relatively "high" level of interpersonal contacts. Conversely, a system with relatively "low" communication integration would be characterized by a relatively "low" level of interpersonal contacts among its members.

Although there is practically no empirical research on communication integration as such, a relatively large number of studies are relevant to an understanding of the problem of integration of communication systems. This literature is the product of a variety of interests and approaches--both conceptually and methodologically--with the result that it constitutes a large body of scattered, unsystematic, information.

One purpose of the present study is to attempt a systematic "ordering" of the available literature relevant to integration, aiming at the development of a conceptual and analytical scheme appropriate for the study of communication integration on a comparative basis, that is, within and across various systems.

It is also our purpose to apply this conceptual and analytical scheme to empirical data obtained in twenty communities of Minas Gerais, Brazil. Our objective is then to be able to develop a "descriptive model" which can be utilized to compare empirically several social systems, in terms of their interpersonal communication structures.

We intend, furthermore, to identify major predictors of communication integration, and analyze the relationship of these predictors with communication integration, in the twenty Brazilian communities.

Students of social phenomena have often used "ideal types"--first proposed by the German sociologist Max Weber, in order to penetrate deeper into social reality, and yet maintain a certain level of abstraction that will allow generalizability and universality. The twenty social systems whose communication structure we will analyze in the present study are treated along a modern-traditional continuum. These are, of course, ideal types, used for convenience of analysis. We shall use, however, an empirical dimension of modernity or tradition, based on the time of adoption of a series of recommended innovations in each social system. Our objective with this typological analysis is to be able to compare communication integration in relatively more modern and relatively more traditional social systems.

Several studies on the modernization process have shown that it is a multi-dimensional phenomenon. We intend to identify some of the major indicators of modernization, and examine the relationship of these indicators to communication integration.

Given certain limitations, such as the lack of a sound theoretical model, as well as certain inherent limitations of the data--which will become more apparent when we discuss the research design--we do not seek prediction in the present study, but rather a synthesis of past research, combined with an understanding and description of communication integration and its correlates in "modern" and "traditional" social systems.

Importance of the Study

Many authors refer to communication as a basic--"perhaps the--fundamental social process," as Schramm (1963, p. 1) points out. One may argue further that communication integration is basic to the other three dimensions of social integration--cultural, normative, and functional--and as such, may even be designated as a major indicator of social integration in general. What we are saying is that the extent of a system's communication integration is likely to bear some relation to its normative and value patterns. The precise nature of these relations awaits research, and as prerequisites for such research, we need to develop conceptual and analytical tools, such as those proposed in the present study.

From both theoretical and methodological perspectives, the study of communication integration is challenging. Some of the questions that are directly pertinent to the problem are, for example: What are the dimensions of communication integration? This is obviously a very general question that can be asked only in conjunction with other questions, such as, for example: How can communication integration be measured? And, again, this latter question is not of interest in itself but merely a preliminary step, which leads to genuine problems of research, such as these: Under what conditions would communication integration increase? Under what conditions would it decrease? What are the consequences of a high degree of communication integration? What are the consequences of a low degree of communication integration? In summary, what kinds of communication integration, in what kinds of communication systems, have what kinds of consequences, for whom?

These are some of the questions that this study will attempt to answer.

The present study has also a practical dimension. The notion that the diverse parts of a communication system normally cohere in some determinate fashion may prove useful in understanding how social systems accept, reject, or adapt innovative messsages which originate from other systems. Administrators, planners, and change agents may be guided by the concept in their effort toward incorporating innovations into a given system.

It is hoped, furthermore, that the present study will contribute to an understanding of specific aspects of the communication process in selected rural areas of Brazil, thus making available additional information on the dynamics of change in the Brazilian scene.

Organization of the Study

The next two chapters of the present study are a review of past research that has conceptual and methodological relevance to the study of communication integration. Chapter IV deals with a framework for the study of communication integration. This framework is drawn mainly from general systems theory. A fifth chapter focuses on communication integration in modern and traditional social systems. Chapter VI deals with the methodology, including such aspects as source of data and operationalization of the variables. The last two chapters of the study deal, respectively, with a comparative analysis of indicators of communication integration, the findings, and a summary, with conclusions and recommendations for further research.

CHAPTER II

REVIEW OF RELATED RESEARCH

Introduction

Our review of the related research literature will be organized into the following categories: (1) the laboratory communication network studies initiated by Bavelas (1948, 1950), (2) small group research, (3) sociometry, (4) formal organization studies, (5) community studies, and (6) macro-level studies in which special attention is given to the role of mass media.

Of these six categories, sociometry, as a research technique, has been used in studies of small groups, and in formal organizations, as well as in a number of community studies. Thus sociometry cuts across at least three of the five research areas included in this review. We feel, however, that the treatment of sociometry as a separate category--rather than in the context of each of these three approaches--is a more systematic way of organizing the present review.

The other five categories constitute an expansion and extension of a related set of categories proposed by

Farace and MacDonald (1971) for the study of communication structures in formal organizations. Their system draws on three types of inputs: (1) the laboratory network studies, (2) the application of sociometry to the study of organizational structures, and (3) the message diffusion research (e.g., Davis', 1953a, 1953b, episodic-communication-channels-in-organization).

The Farace-MacDonald classification represents an effort to order the "chaotic" state of the literature. Their main concern, however, is with communication structures in formal organizations. For our purposes it will be necessary to modify and expand their classification to include the other research traditions indicated previously.

Clearly, this set of six research orientations are not necessarily mutually exclusive--both conceptually and methodologically. They appear to offer, however, several identifying characteristics to justify their grouping into these somewhat distinct categories. Furthermore, this classification provides a useful basis for an analytical view of communication integration at various levels--from the individual level, to the group and societal levels.

The Network Studies

Two papers by Alex Bavelas had a strong impact on the theoretical and experimental aspects of communication structure in small groups. In the first of these papers, Bavelas (1948) builds on Lewinian theory and terminology to focus on such topics as organizational change and group structures, and possible uses of his approach--an application of topological principles--to group behavior. In the second paper Bavelas (1950) introduced the "communication networks" which were to become standard experimental models. In this section we will review first the methodological procedures used in the network studies, and then their major findings.

Procedure

Bavelas' approach to the study of communication network structures consists of arranging small groups (usually artificially organized) in cubicles, interconnected by means of slots in the walls, through which the group members can communicate with each other by means of written messages. Different communication structures may be imposed upon the group by closing any of the cubicle's slots. The most general procedure, however, is to allow continuous message flow within the limitations of the network structure. The links in these networks are mostly symmetrical (two-way), although asymmetrical (one-way) channels are also used in some experiments.

Figure 1 shows examples of 5-member networks, ranging from a more centralized (chain) to a less centralized structure (circle). Other types of networks used in some studies, and not included in Figure 1, are the Y and the comcon (completely connected) structures.

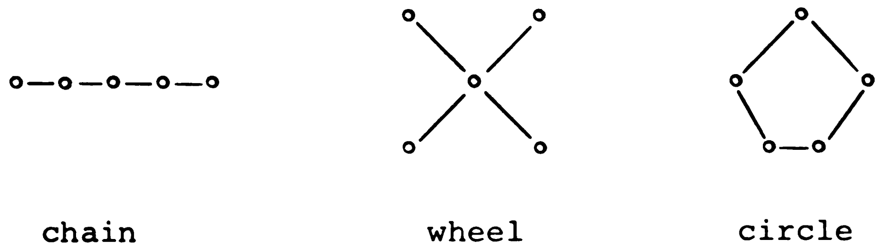

Figure 1. Examples of Communication Network Structures Used in Experimental Studies.

Individual positions in the network structures are measured by counting the distance, d, of each individual to all others. Comparisons among positions within the same network are made by calculating what Bavelas calls the relative centrality, defined by the expression

$$\frac{\Sigma\, d_{x,y}}{d_{x,y}}$$

Comparisons among different network structures are made on the basis of "dispersion" (sum of internal distances), defined as

$$\Sigma\, d_{x,y}$$

Modified versions of the original Bavelas' experiments have been made by other authors. Leavitt (1951), for example, suggests an index of peripherality, which he defines as the difference between the most and the least central positions in a network structure.

Christie and others (1952), and Schein (1958), utilize an "action quantization" procedure to regulate the flow of messages among the network members. Similarly, Heise and Miller (1951) have used an intercom system for the slots, instead of the written messages used in the early experiments.

Questionnaires are generally applied to obtain additional data on specific variables such as leadership, efficiency, group morale, and organization, which are then correlated with group structure and individual position within group structures.*

Major Findings

Two surveys of the literature on communication networks (Glanzer and Glaser, 1961; and Shaw, 1964) tend to agree on the following general conclusion: the experimental studies conducted since the initial work by Bavelas (1948, 1950) have provided a great deal of information about structural effects upon communication networks, but the precise nature of many of the relationships among the variables involved still remain largely unclear.

The following are examples of questions posed in the initial and follow-up investigations dealing with communication networks: "What effect does the structure of the group have upon the efficiency of its behavior?"

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*Surveys of the literature on networks are provided in Glanzer and Glaser (1959, 1961) and Shaw (1964).

"What effect does position in the group have on morale and job satisfaction?" The major independent variables examined in these studies are:* Network structure, individual position within network structures, noise, and task. On the other hand, speed (required to complete a problem), accuracy, leader nomination, message content, organizational ability, morale, status, etc., are examples of the most frequently used dependent variables in these investigations.

Typical of these initial experiments is the one reported by Leavitt (1951). Working with four structures with five members each, Leavitt finds that the wheel, the Y, the chain, and the circle (most centralized to least centralized) rank in descending order with respect to speed to complete a task and agreement on who the network leaders are. On the other hand, circle members show greatest satisfaction, wheel members least, and Y and chain members are intermediate.

As regards the individual position in the network structure, Leavitt finds a positive relationship between centrality and amount of messages sent, satisfaction, and leadership, but a negative relationship between central position and time to solve a problem and errors.

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*Some of these initial and follow-up studies are: Leavitt, 1951; Heise and Miller, 1951; Christie and others, 1952.

In another experiment, Heise and Miller (1951) show that no network is best in all situations, but rather that an interaction between structure efficiency and type of task may exist. The findings of at least two other studies (Shaw, 1954a, 1954b) support this conclusion. In fact, findings of various other experiments (e.g., Guetzkow and Simon, 1955; Morahanna and Argyle, 1960; Cohen and others, 1961) support the general conclusion that the main differences are between centralized and decentralized structures, and that in general, centralized networks will be relatively more efficient with simple tasks, while decentralized structures require less time with complex tasks (Shaw, 1964, pp. 122-24).

Building upon Leavitt's (1951) work Shaw studied communication networks extensively (e.g., 1954a, 1954b, 1954c, 1955, 1956, etc.). He has given special attention to the development of an index of independence, as an alternative measure to centrality and peripherality. Independence is defined as " . . . the degree of freedom with which an individual may function in the group" (Shaw, 1964, p. 125).

Shaw is also interested in the concept of saturation, first described in Gilchrist and others (1954). Two kinds of saturation are observed by those authors: Channel saturation, i.e., "the number of channels with which a position must deal," and message saturation, which refers to the number of messages a given position must handle. Total saturation experienced by a position, says Shaw (1964, p. 126), "is the sum of all input and output requirements placed upon that position."

According to Shaw's investigations (1964, pp. 126-128), independence should be greater in decentralized networks, regardless of the type of tasks. Saturation should be greater in the centralized network with complex task, but less with simple tasks. Independence also tends to be positively related to satisfaction, and saturation negatively related to efficiency.

Small Group Research

The communication network studies described in the preceding section had their roots in the area now identified as "small group research." Much of the writings of Georg Simmel, William James, Charles Cooley, and George Mead, lay in the small group area, but the work developed by these scholars, mostly at the beginning of the twentieth century, was philosophical in nature, or as Homans (1968) indicates, "intuitive" and theoretical. It was not until the 1920's and 1930's that the small group became a serious focus of scientific inquiry. This interest in the systematic study of small groups originated with a number of scholars, apparently working independently and in the framework of different social science disciplines (Deutsch, 1968).

In most of the small group studies, a <u>group</u> is defined as "a number of persons, or members, each of whom, while the group is meeting, interacts with every other, or is able to do so, or can at least take personal cognizance of every other" (Homans, 1968). The number of members that would make a group large, rather than small, is not generally specified, but the groups actually studied have seldom had more than fifty members.

The Western Electric studies, carried out between 1927 and 1932 by Elton Mayo and his associates, are usually considered as the benchmark of an empirical research tradition more closely identified with the field of sociology.*

In these studies, small industrial groups were put under close observation with the purpose of developing conceptual and operational measures of face-to-face interaction. Several investigators (e.g., Whyte, 1961; Homans, 1950; 1961) who were directly or indirectly associated with the Western Electric studies have themselves contributed to the development of small group research.

The work initiated by Lewin (1958) stimulated much of the small group research which is generally identified with psychology. Several of Lewin's students (e.g., Cartwright, 1968; Bavelas, 1950; Festinger, 1950)

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*These studies were carried out at the Western Electric Company's Hawthorne plant in Chicago and became widely known through Roethlisberger and Dickson's (1940) book.

continued his line of inquiry and have indeed made remarkable contributions to the field.

Bound by the traditions of their disciplines, the early investigators in the field of small groups emphasized experimental methods (psychologists) or participant and non-directive type of interviewing (sociologists). Psychologists would generally bring together artificially constructed groups, while sociologists concentrated their efforts on "real-life groups."

Today all investigators tend to use a mixture of techniques which originated with these basic studies. As Homans (1968) indicates, "Most investigators [in the field of small groups] now think of themselves as social psychologists rather than psychologists or sociologists."

In a recent article, Deutsch (1968) indicates that by 1960 the field of small group research had "mushroomed" to over 2,200 published works, more than 80 per cent of which appeared between 1950-1960. Since 1960, he says, articles have been appearing at the rate of more than 250 per year. It is not possible, therefore, to present here a detailed account of this impressive outpouring of research. The present review is, by necessity, selective.*

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*Cartwright and Zender (1968), Olmstead (1959), Hare (1962), Hare and others (1965), and McGrath and Altman (1966) provide useful summaries of the literature on small group research.

The findings of small group research are varied and "formulated in many different terminologies: almost every investigator makes up one of his own" (Homans, 1968). In general, however, these findings have been interpreted within two main bodies of theory: Sociological and psychological.

While the propositions of the sociological type of theories are about social units (the group as such), those of the psychological theories are about the behavior of individual men. An example of the first type of theory is that of Bales (1950), and one of the psychological type is that of Homans (1950, 1961).

In an attempt to identify the most significant ways in which groups differ from one another, Deutsch (1968) examines several variables, the most relevant of which, for our purposes, are group size and cohesiveness.

Group Size

The _size of a group_, defined as the number of its members, has two interrelated properties: One is statistical and the other psychological. The statistical properties of size are related to intragroup variability, the probability of the occurrence of any characteristic, and other similar dimensions. For example, as a group size increases, its heterogeneity will also tend to increase. Similarly, as the size of a group increases, its number of potential interpersonal relations will be larger. For instance, the number of possible dyadic relations in any group of size N will increase according to the formula $(N^2 - N)/2$, or $N(N-1)/2$.

On the other hand, as the size of a group increases, a smaller proportion of the possible direct links among its members will tend to be formed, because the capacity of a person to establish close communication with others tends to be numerically limited.

The psychological properties of size are related to the group milieu. Research has shown, for example, that as the size of the group increases, the intellectual functioning of its members will tend to deteriorate (Deutsch, 1968).

Bales (1951) and Stephan and Mishler (1952) have found that participation tends to be less equal among the members of a group as its size increases. These results suggest that individuals who tend to be shy are unlikely to participate actively in larger groups, although they may contribute much in small groups. On the other hand, individuals who tend to be assertive are likely to have a disproportionately large influence in larger groups as compared with smaller groups.

The size of the group is also likely to affect members' satisfaction. Laboratory and field studies both indicate that members of smaller groups are more likely to feel satisfied with their group, and less likely to develop cliques and factions. Larger groups, on the other hand, are characterized by more formality, and more internal conflicts than are smaller groups (Deutsch, 1968).

Group Cohesiveness

Group cohesiveness refers to the degree to which members are bound together in a group, or as Festinger (1950) defines the concept: "Cohesiveness is the resultant of all the forces acting on the members to remain in the group."

Most efforts to measure cohesiveness of a group have been guided by the implication that cohesiveness varies with mutual attraction and/or attraction to the group (Shachter, 1968).

Cartwright (1968, pp. 91-109) quoting several small group researchers, discusses group cohesiveness in terms of interpersonal attraction and mutual liking. Similarly, Lott and Lott (1965), in a very comprehensive review concerning group cohesiveness, define the concept in terms of interpersonal attraction.

Blau (1960) offers a theory of social integration which he derives mainly from Homans' (1950) notions of "exchange processes." Blau's theory is built around the concepts of attraction and cohesiveness. He defines group cohesiveness "as the prevalence of integrative bonds among group members." A group is cohesive, says Blau

(1960), if ties of social attraction interlink its members. Social integration is a function of group cohesiveness, which in turn depends on members' attraction to one another.

Of the many aspects of group behavior that interact with cohesiveness, the most thoroughly studied area is that of communication and social influence (Schachter, 1968). Research findings tend to indicate that cohesiveness is consistently associated with greater communication within the group. On the other hand, intragroup communication tends to increase group cohesiveness (Deutsch, 1968).

Results of an experiment by Back (1951) show that when people are more attached to each other, they exert greater influence over each other's opinion, and are more effective in their influencing.

Some small group studies attribute a positive correlation between an individual's acceptance in a group, as measured by interpersonal attraction, or cohesiveness, and innovativeness. Hollander (1964, p. 206), for example, found a positive correlation between an individual's status in his group and the group's approval of his deviancy; "this relation," says Hollander, "should hold especially in the case of innovative deviancy."

Sociometry

As already indicated, sociometry has been used in small group research, in community studies, as well as in organizational studies. The first applications of sociometry were studies of small groups, conducted by Moreno and his associates (1953, 1960). It is fit, therefore, to include our discussion of sociometry after the section on small groups. As we shall see in the course of our discussion, various sociometric indices developed in the context of small group research.

Kerlinger (1964, p. 554) defines sociometry as "the study and measurement of social choice." Sociometry has also been called, says Kerlinger, "a means of studying the attractions and repulsions of members of groups."

In a broad sense, sociometry refers to various techniques of measurement, data-gathering and analysis, of interaction patterns and communication structures in social systems. Sociometry is a simple and straight forward procedure that can be adapted to most situations, ranging from a small group of three or four members, to a large and complex social system.

The nature of sociometric testing may range from a single question on a single item (e.g., "Who are the people with whom you talk most frequently in group X?") to a series of questions designed to uncover various different aspects of social relations. Questions may vary as regards topic, frequency of communication, etc., and may be either open or closed, but no matter its form, a sociometric question always retains its interpersonal character. This factor alone makes the sociometric question an excellent measuring device for communication studies.

Originally, sociometric data were analyzed by means of a sociogram, a representational device used to illustrate certain types of relations (usually two-valued) between pairs of individuals in a social system. The analytical utility of the sociogram is, however, limited, since such analyses are usually restricted to describing relationships. Besides, when the number of elements in a system is relatively large, or when the number of choices allowed each respondent is also large, the communication structure tends to increase in complexity, with the result that the pictorial representation of these relationships may become cumbersome and difficult to comprehend.

Forsyth and Katz (1946) developed an alternative procedure for handling sociometric data, the sociometric matrix, or sociomatrix. This is a matrix of N by N dimensions corresponding to a social system of N persons. Their procedure is simply to list the persons in the system along the rows and the columns in the same order. The rows correspond to the communication sources, and the columns to the receivers. Plus and minus signs are used for positive and negative choices--if desired, and blanks for no contacts. The original matrix is manipulated to produce a new matrix which will show, in a cluster along the main diagonal, the persons who have positive mutual choices; those who do not choose each other are relatively separate.

Despite some obvious advantages over the sociogram, the sociomatrix is still a laborious device, and more important, it remains essentially a descriptive tool.

The next major development in the analysis of sociometric data was noting that they could be represented in the form of matrices with binary entries. In its simplest form, the interconnections within a communication system would be represented by a 0-1 matrix, that is, a matrix with a_{ij} = 1 or 0. As shown by several authors (Katz, 1947, 1952; Hohn, 1953), the use of binary matrices opened up many analytical possibilities, stimulating also the development of various types of sociometric indices.* Many of these indices center on individual characteristics, others deal with group variables. A simple index is the measure of group cohesiveness, which is the proportion of mutually chosen pairs to the total number of possible pairs, and is represented by the following expression:

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*A survey of the literature on sociometric indices is found in Proctor and Loomis (1951). Kerlinger (1967) also discusses some basic sociometric indices.

$$Co = \frac{\Sigma(i \longleftrightarrow j)}{\frac{n(n-1)}{2}}$$

where Co represents group cohesiveness, and $\Sigma(i \longleftrightarrow j)$ the sum of mutual choices (or mutual pairs).

The above formula is suitable for a situation in which respondents have unlimited number of choices. When dealing with a limited number of choices, the formula for the cohesiveness index becomes:

$$Co = \frac{\Sigma(i \longleftrightarrow j)}{dn/2}$$

where d corresponds to the number of choices each person is allowed.

Other similar indices have appeared in the literature (e.g., a concentration index proposed by Katz, 1954; a hierarchy index suggested by Landau, 1951, and Hohn, 1953). Various individual level indices have also been proposed; the simplest of these is based on the sum of the rows and columns of the binary (0-1) matrix. This is, however, a limited measure, especially when dealing with groups of unequal size.

Proctor and Loomis (1951) suggest a useful and simple individual index, which they call choice status, CS:

$$CS = \frac{\Sigma\ c_j}{n-1}$$

where Σc_j corresponds to the sum of choices in column j, in the binary matrix, and n-1 to the number of persons in the matrix minus the nominator himself.

One difficulty with these indices is that they only take into account direct connections between members of a network, thus eliminating the possibility of analysis of communication, or influence, on an indirect basis, that is, through other persons.

These various developments in the field of sociometry, many of them parallel to small group research, encouraged the use of sociometric devices in several other research areas, one of these areas being formal organization, discussed next.

Formal Organization Studies

As already pointed out, there are at least two major research approaches in the area of organizational communication that seem relevant for the present discussion. One such approach makes use of sociometric techniques as a measuring and analytical tool, while the other approach uses the ECCO research strategy developed by Davis (1953). We will discuss first the sociometric-oriented research.

Organizational Studies Using Sociometric and Related Techniques

Jacobson and Seashore (1951) pioneered in the application of sociometric techniques to the analysis of communication structures in formal organizations. Their study focused on four major communication aspects of a large government agency: (1) frequency of contacts (among the 200 subjects included in their sample), (2) subject matter of communication, (3) reason for contact, and (4) importance of communication.

By placing the dyadic (or reciprocated) connections in a 0-1 matrix, and then manipulating the matrix in a similar, but improved, fashion to that described in Forsyth and Katz (1946), Jacobson and Seashore (1951) identified and analyzed various structural aspects of the communication system they studied. Two other major investigations followed the Jacobson-Seashore study. These are the studies conducted by Weiss and Jacobson (1955) and by Weiss (1956). These three pieces of work constitute the initial efforts to analyze communication structures in formal organizations using a combination of sociometric techniques, graph theory, and matrix algebra.

The basic procedure followed in these studies, as described mainly in Weiss (1956), is to re-order the symmetrical matrix in such a way that the "1" entries would be "concentrated closer to the diagonal than they were in the original matrix" (Weiss, 1956, p. 90). The next step is to partition the matrix to obtain submatrices of 1's (along the diagonal), and of 0's (off the diagonal). The process is repeated, and frequently the matrix is squared, for additional analysis.* Through these procedures one is able to "map" the communication system and identify its major structural elements.

A special terminology--derived partly from graph theory--has evolved out of these studies. Weiss and Jacobson (1955), for example, use the term liaison person "as an individual who worked with at least two individuals who were members of work groups other than his own." Work group refers to a set of persons "whose relations were with each other and with members of other work groups, except for contacts with liaison persons or contacts between groups" (Weiss and Jacobson, 1955).

Weiss (1956, pp. 88-89) uses the terms single bridge and double bridge, the former meaning a connection (or contact, in his terminology) between groups, which does not involve a liaison person; the latter is used to describe contacts that join two groups. Another term used in Jacobson and Seashore (1951) is isolate, defined as a person who neither seeks nor is sought by others, in the communication system.

Figure 2, adapted from Weiss (1956), illustrates these various concepts.

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*By squaring a matrix one can determine the two-step connections in the system. These procedures were first suggested by Festinger (1949) and by Luce and Perry (1949), and are reviewed in detail in Guimaraes (1968; 1970).

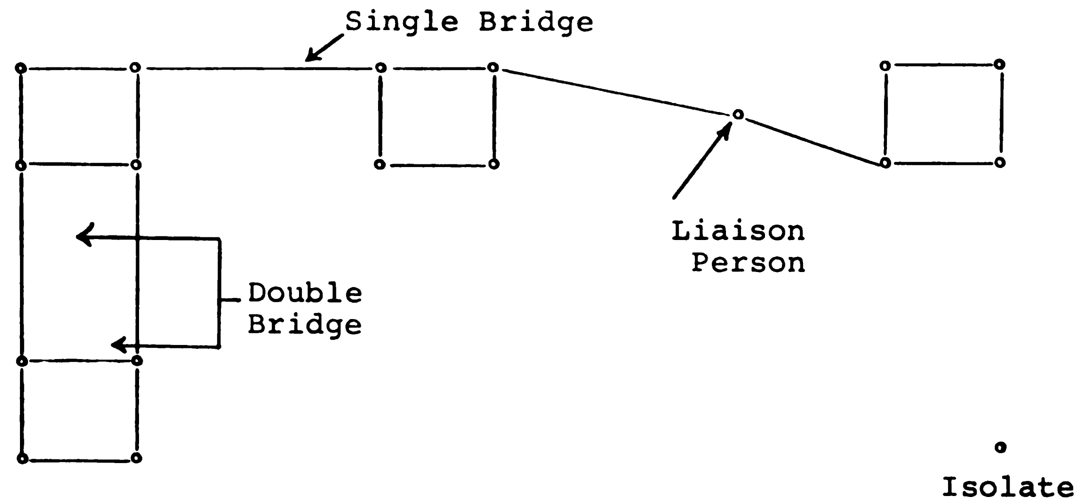

Figure 2. Illustration of Terms Used in Some Formal Organization Studies.

Some recent studies have followed up these earlier efforts. One was made by Schwartz (1968), the other by MacDonald (1970), and a third one, by Amend (1971). The Schwartz study focuses mainly on liaison roles and their correlates. MacDonald compares liaison and nonliaison roles, and examines a series of hypotheses about the communication behavior and other related characteristics of these two types. Amend's study also focuses on the liaison role and selected communication variables. These studies follow closely the procedures outlined in the Weiss (1956) study. Two additional studies dealing with communication structures in school systems are reported by Rollins and Charters (1965), and Allen (1970).

<u>ECCO Analysis</u>

The ECCO (episodic-communication-channels-in-organization) method was introduced by Davis (1953a), in a study of a manufacturing company. The procedure consists of analyzing the "flow" of "episodic communications" in an organization as a means of identifying its formal and informal structures. In one of Davis' (1953b) studies, he finds that the frequency and intensity of communication is positively related to positions within an organization--higher-level personnel tend to communicate more often with more employees than persons in lower levels. Davis' results show also that communication tends to flow more horizontally and downward, rather than upward; and that communication by word-of-mouth is more frequent and faster than written communication.

Replications of the original Davis study were made by Sutton and Porter (1968) and by Marting (1969). The Sutton-Porter study confirmed two of Davis' findings, that is, that position within the organizational structure and informal communication are positively related, and that there is a relatively small number of liaison persons in the informal communication structure--Davis identified only 10 percent of individuals who performed liaison roles. Marting (1969), however, found that the number of liaison persons in her study was about 18 per cent, and that there was no significant difference of communication between high- and low-level personnel.

The Community Studies

There are a variety of studies that have used sociometric data to identify and analyze communication networks in communities. Some of these studies have focused on how informal friendship ties operate as links in a communication network. Others have analyzed interpersonal communication as an influence channel in the process of innovation decisions. Many of the latter type of studies come from the literature on the diffusion of innovations, although some are studies of interpersonal influence and opinion change in the areas of voting behavior, marketing, public affairs, and so on.

Our major concern here is with studies focusing on informal friendship ties, rather than on the interpersonal influence studies. We shall review first some methodological aspects of these studies, and then their major findings.

The Use of Matrix Multiplication in the Analysis of Sociometric Data

Festinger, Schachter, and Back (1950, pp. 132-147) applied a matrix multiplication approach to sociometric data on friendship relations from two neighborhoods.* The technique consists of raising the binary matrix (0-1)--in

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*This matrix multiplication technique was first proposed by Festinger (1949) and Luce and Perry (1949), and has been reviewed by Guimaraes (1968; 1970).

which the communication links among the various system members are recorded--to n-powers in order to determine n-chains or n-step connections among the network members as well as the tendency toward clique formation. If A is a square matrix, its powers can be formed as

$$A^2 = AA,\ A^3 = A^2A, \text{ etc., and } A^\circ = 1.$$

The entry of a square matrix, A^2, is:

$$A^2_{ij} = a_{i1}a_{1j} + a_{i2}a_{2j} + \ldots + a_{in}a_{nj} .$$

By squaring the original binary matrix (0-1), A, one obtains the <u>two-step</u> connections between the network members. By raising matrix A to the 3rd, 4th, and nth powers, one obtains the 3rd, 4th, and nth step connections.

<u>Clique identification</u> is performed more efficiently by extracting a symmetrical submatrix, S, of the original binary matrix, A, and then raising S to the 3rd power. If an individual's cell in the main diagonal of matrix S^3 has a value other than zero, he is a member of a clique. Otherwise he is not.

<u>Major Findings</u>

Festinger and his associates (1950, ch. 7) found that rumor tends to spread along friendship lines. "Friendship between two people," they say, "implies the existence of an active channel of communication." Katz and Lazarsfeld (1955, pp. 44-45) also refer to interpersonal relations as "channels of communication."

A study conducted by Coleman, Katz, and Menzel (1966), among physicians in four Midwestern communities, made extensive use of sociometric questions to identify and analyze the friendship, informal discussion, and advice-seeking patterns among the respondents in connection with the use of a new drug. As indicated in Katz (1963, p. 84), "Of all the factors found relevant to speed of adoption of the new drug, a doctor's integration in the networks of interpersonal communication was about the most important" [italics added]. Doctors who were communication catalysts for other doctors--that is, those who were identified as friends, informal consultants, and worth seeking for information about medicine, were also the ones who used the drug in their practices relatively earlier. Isolate doctors, on the other hand, were the last ones to use the drug (some never did use it).

Drawing on the findings of the drug study, Katz (1963, pp. 84-85) proposes two diffusion models. One such model would reflect a "social" process of diffusion. "The diffusion curve for the sociometrically integrated doctors," says Katz, "fits a 'social' model in which it is assumed that the earliest users of the innovation influence their associates who, in turn, influence their associates, and so on." The diffusion curve for isolated doctors, on the other hand, would fit the "individualistic" model, characterized by the absence of a successive chain or network of interpersonal communication.

The drug study has been compared with earlier studies that had also attempted to relate interpersonal communication structures with innovative behavior. One of these earlier studies is the one conducted by Ryan and Gross (1943), on the diffusion of hybrid-seed corn in two Iowa communities. The Iowa study concluded that <u>interpersonal influence</u> was a major factor in the adoption of the new seed, but that <u>integration</u> in the communication structure, as measured by <u>informal ties</u>, was not predictive of time of adoption.

In an attempt to reconcile these apparently contradictory findings, Katz (1963, pp. 86-87) argues that if "progressive" social systems are compared with "conservative" social systems--it is found that the more integrated members of "progressive" communities will have adopted a greater number of recommended practices than the average member, while the integrated members of the "conservative" communities will have adopted no more than average. Katz is apparently trying to show that in a social system whose dominant norms support change--"as it presumably does in a medical community"--there is reason to expect informal <u>communication integration</u> to be positively related to <u>innovation</u>. In a <u>traditional community</u>, however--the Iowa communities were considered traditional by the authors of the study--it may well be the less integrative members who innovate.

Some anthropological studies lend support to the latter position. Barnett (1953, p. 404), for example, views innovators as "Individuals with the least opportunity for full participation in the most valued activities of their own society." This position is also supported by at least one sociological study. Ben-David (1960), for example, found that marginal men are responsible for many scientific and social innovations.

In a study of public health innovations, Becker (1970) proposes that individuals who are centrally located in a communication network would be early adopters of innovations which are both approved and disapproved by the network members, while those persons in marginal locations in the communication network would be most likely the early adopters of unpopular innovations. Becker's argument to support his position is essentially similar to Katz's. He contends that "When the norms of a particular social group favor change, progressive behavior will be located in group leaders; but, if the norms favor maintenance of the status quo, the leaders will retain a conservative approach, while marginals will assume the role of innovators."

Several studies completed in the United States (e.g., Marsh and Coleman, 1956; Wilkening, 1952; Rogers and Beal, 1958) support the notion that the integration of informal interpersonal channels is an important factor in the innovative process. Studies conducted in developing societies have shown also that the role of interpersonal communication is crucial in the process of adoption of new ideas. Two examples of these studies are the Deutschmann and Fals-Borda (1962) study conducted in Colombia, and the Myren (1962) study carried out in Mexico.

In a comparative study of two Israeli communities, Weintraub and Bernstein (1966) report that the relatively more modern community had a much more integrated communication network, as measured by informal friendship ties.

A study of eighteen Nigerian villages (Leighton and others, 1963), in which a measure of interpersonal relations was used as one of the two indicants of social and cultural integration, shows that the most integrated villages tended to be those with relatively higher modernizing features, as represented by level of living, educational aspirations, the desire to leave the village for a larger town, exposure to outside news, etc. The relatively less integrated villages, on the other hand, were more traditional in their way of life, and showed relatively higher incidence of mental disorders.

In a comparative study of two Indian villages, Rao (1966, pp. 57-59) reports considerable differences between a more modern and a more traditional village, in terms of their interpersonal communication networks. "The difference in amount of interpersonal communication is not too great. What is striking," says Rao, "is the pattern."

In the more developed village, "contacts are spread over a wider area," whereas in the traditional village "communication is limited to specific groups." The more developed village shows a relatively more integrated system of communication than the more traditional village. In the more developed village people "talk freely among themselves irrespective of socioeconomic differences," while in the more traditional village there is a communication gap between elite and the "ordinary people."

Results of a study by Yadav (1967, pp. 151-159) also comparing a relatively modern and a relatively traditional village in India, tend to confirm Rao's findings. Yadav found that the range of social interaction, defined as the sum of direct (one-step) and indirect (two-step) interpersonal communication contacts was larger in the modern social system than in the traditional social system. Yadav also found greater number of contacts between subgroups in the modern social system than in the traditional social system. Another of Yadav's findings, is that the communication structure of the modern social system had a greater number of liaison persons, as compared with the traditional social system. Yadav further analyzed the characteristics of liaison persons, as compared to non-liaison persons, and found that liaison persons were both relatively more innovative and more exposed to mass media.

Macro-Level Studies

Some studies have dealt with the problem of consensus on a macro-level and the term consensus becomes at times somewhat analogous to communication integration. It seems useful, therefore, to briefly review some of these studies.

Wirth (1948) speaks of the importance of mass media of communication in achieving consensus in modern societies. He says that "Consensus is supported and maintained not merely by ties of interdependence and by a common cultural base, by a set of institutions embodying the settled traditions of the people, and the norms and standards that they imply and impose . . . but also . . . by the continuing currents of mass communication . . . which hold [society] together and mobilizes it for continuous concerted action."

Shils (1962) argues that the mass media have closely interconnected the center and the periphery of modern societies. He believes that this connection between the periphery and the center of a society consists in the attachment of the masses to the central institutions and value systems of the society. According to this notion, communication integration is closely associated with the normative patterns of society. "The mass society," says Shils, "is not the most peaceful or 'orderly' society that has ever existed; but is the most consensual."

Consensus is defined as agreement among the members of a society. "It exists when a large proportion of the adult members of a society, more particularly a large proportion of those concerned with decisions regarding the allocations of authority, status, rights, wealth and income, and other important and scarce values about which conflict might occur, are in approximate agreement in their belief about what decisions should be made and leave some feeling of unity with each other and with the society as a whole" (Shils, 1968).

Lazarsfeld and Merton (1948) assert that the mass media maintain cultural consensus by reinforcing norms. This is the reinforcing latent function of the media. Janowitz (1952) found that Chicago weeklies maintain local consensus by emphasizing common values rather than attempting to solve "value-in-conflict" problems.

These and other studies of this nature, carried out mostly by content analytical procedures, support the notion that one of the latent functions of the mass media is to reinforce cultural tradition and at the same time act as a socializing agent for new roles. "Members of the society thus remain integrated within the socio-cultural structure. As a form of adult socialization, the media are seen as guarantors that a body of common ultimate values remain visible as a continuing source of consensus, despite the inroads of change" (Breed, 1958).

Summary

The major purpose of the present chapter was to review the research literature relevant for the study of communication integration in local social systems. This review was organized around six categories: Sociometry, a research technique, and five substantive areas, that is, network studies, small group research, organizational studies, community studies, and macro-level studies.

The network studies focus primarily on the communication structure of artifically organized small groups and their relationships to such variables as: Organizational ability, efficiency in the performance of a given task, leadership, morale and job satisfaction, and so on.

The small group area developed out two major research traditions: Sociological, which began with the Western Electric studies directed by Elton Mayo, and psychological, initiated by Kurt Lewin.

The first applications of sociometry were studies of small groups, conducted by Moreno and his associates

(1953, 1960). The uses of sociometry were later extended to community studies and other complex systems, such as formal organizations.

The area of organizational communication has two major approaches: Sociometric-based techniques, pioneered by Jacobson and Seashore (1951), and the ECCO (episodic-communication-channels-in-organization) approach, developed by Davis (1953a).

A variety of community studies have used sociometric techniques to identify and analyze communication structures. Some of these studies have focused on informal communication networks, others have analyzed interpersonal communication as an influence channel in the process of innovation decisions.

Some studies have dealt with the problem of consensus on a macro-level. Most of the studies dealing with societal consensus have been carried by content analytical procedures.

A considerable amount of research, in each of these six categories, shows conceptual and methodological bearing on the study of communication integration. It is useful to examine in some detail the implications of this past research for the present study. This can be best accomplished in a separate chapter. The next chapter is therefore devoted to this task.

CHAPTER III

IMPLICATIONS OF PAST RESEARCH FOR THE PRESENT STUDY

Introduction

As shown in the preceding chapter, there is a voluminous research literature that has a direct bearing on the study of communication integration. The objective of the present chapter is to examine in some detail the conceptual and methodological implications of this literature for our study.

The first five sections of this chapter deal more directly with the conceptual implications of each of the five substantive research areas reviewed in the last chapter, that is, the network studies, small group research, formal organization, and the macro-level studies. The last section focuses more specifically on the measurement and analytical techniques of these studies and their contribution to the present thesis.

The Network Studies

The experimental communication network studies have contributed to the development or improvement of various techniques of measurement and analysis. The available literature on communication networks offers, however, relatively little in terms of a systematic theory that will allow further research development in this field. Furthermore, conflicting results are found in some of the studies completed. This lack of theoretical growth, added to the problem of conflicting research results, might have been a major factor in the obvious decline in the number of network studies reported in the literature, especially in the last few years.

These difficulties in theory building and conflicting findings appear related to the rather limited application of the methods, concepts, and results of this research tradition to other areas, represented by larger, "natural" social systems, such as communities.

Katz and Lazarsfeld (1955, p. 8) call attention to a gap that apparently existed between small group research in general and field surveys. Authors in small group research, Katz and Lazarsfeld point out, "had paid little attention to the way in which their work was related to the large body of knowledge concerning the mass media; nor had they questioned how the results of experiments could be related to findings of large-scale surveys. . . ."

Since Katz and Lazarsfeld made these observations, some efforts have been made to "close the gap" between small group research, in general, and field surveys. A gap seems to persist, however, between laboratory communication network studies and field surveys.

Communication network experiments have not attempted to relate their findings to large-scale field surveys, and have made only cautious application of their findings to larger settings, such as formal organizations. On the other hand, communication researchers engaged in large-scale field surveys have overlooked measurement and analytical techniques, as well as variables that have been shown to be quite important in communication network studies conducted under contrived conditions. Some of these variables are centrality, independence, saturation, leadership, efficiency, and satisfaction.

Centrality is particularly relevant for our present purposes, since it is conceptually (and operationally, as will be seen in a later chapter) analogous to our view of communication integration.

One of the substantive findings of the network studies is that centralized communication structures tend to be relatively more efficient (in the performance of a given task) than decentralized structures. As indicated earlier, one of the major objectives of the present study is to examine whether communication systems which exhibit a relatively higher degree of integration will be also those which are more receptive to innovations, and can therefore be considered more "modern," or more "efficient."

Small Group Research

Unlike what has been observed with respect to the research tradition centering on communication networks, many small group researchers have carried over their methodological and conceptual tools to "larger," more complex, social systems. Festinger, Schachter, and Back (1950, ch. 7), for example, analyze the interpersonal communication networks involved in rumor transmission in two neighborhoods. Back (1951) also studied the process of rumor transmission in an industrial organization, and attempted to generalize some of the findings of small group research to formal organizations. In fact, there has been so much overlapping of small group research with other research orientations that it becomes difficult to make clear cut distinctions between this area and other research traditions generally identified with larger social systems.

As indicated in the preceding discussion, the concept of cohesiveness--a central variable in many small group studies--emphasizes the notion of mutual attraction among group members, and often, also, attractiveness to the group. Our concept of communication integration is somewhat analogous to this notion of cohesiveness, although communication integration refers more directly to the interconnection of the structural components of the communication system. Our focus is on the role (or role system) within a given communication system, rather than on individuals performing these roles. This is obviously an analytical distinction, since in actuality it is not possible to have roles without their occupants. Nevertheless, it is useful to make this distinction, since it allows for a higher level of abstraction.

One aspect of past research that is particularly important for our purposes is the attributed positive relationship between cohesiveness and innovativeness, or as Hollander (1964) puts it, "innovative deviancy." Diffusion theory and findings (Rogers, 1962) show, indeed, a positive relationship between innovativeness and the individual's location in his (informal) group. Typically, persons occupying relatively central positions in communication networks are found to be early adopters, while those outside the network are found to be late adopters (Becker, 1970).

The size of a group is directly associated with its number of potential contacts and, it seems, inversely associated with the actual number of links among its members, in proportion to those possible.

Group size tends to be also inversely related to equality of participation among its members. Similarly, smaller groups tend to provide a more favorable climate for their members, and thus, less conflictive and cliquish developments.

It may be inferred, therefore, that smaller groups will be more conducive to communication integration among their members, in comparison to relatively larger groups.

Formal Organization Studies

The formal organization studies are both conceptually and methodologically relevant for our present context. The particular studies using sociometric and related techniques are, however, more directly pertinent to our own purposes.

The ECCO (episodic-communication-channels-in-organization) approach offers some potential for the study of communication structure of social systems in general, but so far it has been used only in organizational settings. Even in the context of formal organizations, where a specific set of messages can be identified relatively easily, and their diffusion traced by the investigator, the approach may offer only a partial picture of the communication structure, depending on the particular issue being analyzed.

The ECCO approach seems, therefore, more appropriate for the analysis of message diffusion, rather than of structural properties of communication systems. Other methodologies, such as simulation, have been used successfully in studies of message flow in a community context. The latter approach has reached a relatively high level of methodological sophistication. One example of a simulation study is the one conducted by Carroll (1970) in two Brazilian communities.

One limitation of the sociometrically oriented studies lies in the use of some terms, such as work group. As pointed out by MacDonald (1970), the term work group, as defined in these studies, can be misleading, since it refers to communication groups, rather than to actual groups whose function is to carry on an organization's tasks and objectives. The term clique seems more appropriate to represent an informal, communication group. One problem with this term is that it may be variously defined. Festinger, Schachter and Back (1950), for example, define a clique as the subgroup in which at least three members mutually interact. Following Farace and Morris (1969), we define a clique as any subsystem whose elements interact with each other relatively more frequently than with other members of the communication system.

Another problem inherent in sociometric-based organizational studies, is their use of reciprocated contacts (symmetric links) alone when identifying and analyzing certain key structural variables, such as liaison roles, bridge contacts, and cliques. In the context of formal organizations, this procedure may seem plausible;

however, in "natural" social systems, such as communities, symmetrical relations may not be so frequent, especially when the respondents are allowed a limited and relatively small number of choices.

Thus, the elimination of non-reciprocated contacts may change the configuration of the communication structure in a community. One solution for the problem would be to define dyadic relations on the basis of one-way, rather than two-way, nominations. This is, however, a less stringent definitional approach.

One further observation refers to the procedures in the construction and repeated rearrangement of the binary matrices. As pointed out by MacDonald (1970), the laborious and tedious process involved in these tasks, which may involve hundreds of man-hours, might constitute a serious barrier that prevents the replication of some of these studies, and eventually, the improvement of methodological and conceptual schemes in this area of interest. The solution is obviously the computerization of the procedures. A step in this direction is now being made, as described by Richards (1971).

It should be emphasized, finally, that the Jacobson-Weiss-Seashore studies pioneered in the application of some graph theoretical principals to the study of social structures. This constitutes in itself a valuable contribution.

The Community Studies

One of the major implications of the community studies for our present study is the notion that friendship ties represent a valid indicator of active communication channels, the implication being that social systems characterized by a relatively larger number of informal friendship relations have also more interpersonal communication channels available.

Another important finding coming out of the community studies refers to the role of communication integration in the innovation diffusion process. Studies conducted both in the United States and in developing societies show that integration within the communication network is a major factor in this process. If we accept Katz's (1963) propositions, we may say that relatively more integrated communication systems fit into the "social" model of diffusion, while systems characterized by relatively low levels of integration would fit his "individualist" model.

The relatively more integrated systems would tend to be more innovative while the relatively less integrated systems would tend to be less innovative. The Yadav (1967) study points also to the differences between a "more modern" and a "more traditional" village in India, with respect to the number of liaison roles and subgroups. The relatively more modern village had more of both.

Macro-Level Studies

Most studies focusing on consensus are concerned only with what Shils (1968) calls the "macrosocial consensus" of society. As such, the notion of consensus differs from our concept of communication integration which, as already indicated, emphasizes the structural aspects of the communication system, and is placed here in a context of local social system, rather than in a societal context.

It remains to be said, however, that modern society tends to a "mass society," which is characterized by a higher degree of consensus (Eisenstadt, 1966), and hence, greater structural interconnectedness, or communication integration.

Methodological Implications of Past Research

Results of the studies reviewed in Chapter II show that sociometric techniques are useful tools in the identification and analysis of communication structures. As indicated in that review, the manipulation of sociometric data evolved from the merely descriptive sociogram, to the use of sociomatrices, and the binary matrices, which led to more refined techniques, such as matrix multiplication.

It is interesting to note that most of this methodology lay dormant for several years, and its potential has not been fully appreciated by communication researchers until recently.*

The use of matrix multiplication in the analysis of sociometric data allows the identification of formally defined structures within a communication network, as well as the analysis of indirect connections. As Festinger and others (1950, pp. 140-142) point out, the meaning of these indirect connections between group members is quite important, be they indicative of informal communication channels, interpersonal influence, or any other type of interpersonal relationships. For example, if one is dealing with sociometric choices designed to trace channels of interpersonal communication, the squared matrix, A^2, would show that a given item of information originating with person x would reach persons v, w, and z in two steps. If any of these three persons is an individual who can both send and receive messages--a liaison person, for example--the item of information may also be received (in three-steps) by persons q, u, etc. On the other hand, if individual v, for example, can receive but not send messages (because he may not have a channel going from

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*The author reviewed in detail this methodology (Guimaraes, 1968, 1970), and found only three recent communication studies (Lin, 1968; Lingwood, 1970; and Yadav, 1970) that make use of this technique. Much of the present discussion is taken directly from Guimaraes (1970).

him to other persons in the system), the item of information that reaches him would not be passed on to other members of the network.

If one is interested in measuring interpersonal <u>influence</u> within a social system, matrix A would indicate that person *x* exerts <u>direct</u> influence upon person *y*. The squared matrix, A^2, would, however, indicate the extent of <u>indirect</u> influence which person *x* has within the system, since it shows which other persons he influences indirectly, that is, through *y*, *z*, etc.

By adding the original and the squared (or nth) matrices, the investigator may know, for example, how many elements in the communication system receive any particular item of information if this message is started with person *x*. He may also obtain answers to such questions as: "Who influences whom" in a specified number of steps? "Which elements are influenced by only a few other elements, and which are influenced by a large number of them?" "What proportion of all possible connections actually exist?"

Knowledge of the indirect connections within a communication network may also provide the criteria for classifying people according to their position along n-chains (i.e., one-step, two-steps, etc.) in regard to a given information input. The nth matrix can be partitioned into submatrices representing persons who exhibit similar (or different) characteristics along the n-chain dimensions. Lin (1968) combined _awareness_ data (i.e., time of initial knowledge of an innovation) with sociometric data for three Michigan high schools, by ordering the respondents in the matrix, A, so that the earliest knower occupied the first row and column in the matrix, while the latest knower occupied the last row and column. Three types of submatrices originated from this procedure, each representing one distinct communication pattern:

1. _Upward communication_, representing a respondent's nomination of another member of the system who had become aware of the innovation earlier than himself.

2. _Downward communication_, representing a respondent's nomination of another person who had become aware of the innovation later than himself.

3. _Horizontal communication_, representing diagonal cells.

Clearly, similar procedures may be applied to other social systems.

Despite its utility, one should be cautioned that the use of matrix multiplication for the analysis of communication data has its limitations. One of these limitations relates to the problem of _clique_ identification. As described earlier, _cliques_ may be best identified by extracting a symmetrical submatrix, S, of the original matrix, A, and then raising matrix S to the 3rd power (to determine three-step, mutual connections). However, when dealing with situations in which an individual is a member of more than one clique, the use of matrix S^3 is not of much help. Besides, this procedure is conceptually dependent on Festinger and others' (1950) definition of a clique, which assumes mutual communication of at least three persons. One alternative, of course, is to refer back to the original matrix, A, where the interconnections and cliques may be traced.

Several authors (e.g., Chabot, 1950; Harary and Ross, 1957; Katz, 1953; Hubbell, 1965) have dealt with the problem of multiclique detection; however, a satisfactory and, more important, relatively easy and manageable solution, has yet to be found.

Another problem that arises with the use of matrix multiplication has to do with the precise identification of what Luce and Perry (1949) define as <u>n-chains</u>, i.e., links of n-steps in length from i to j. Cartwright and Gleason (1966) discuss this problem within the framework of graph theory, and prefer to use the terms <u>paths</u> and <u>cycles</u>. The problem, however, the context of its discussion, is to find the number of ways one can go from one position in a network to another, using a given number of connections, without passing through any position more than once. One may want to know, for instance, how many ways a message can go from person x to person z through a network in exactly n-steps while satisfying the requirement that no person hear the message more than once.

The method of matrix multiplication allows what Coleman (1964, p. 447) calls "doubling back," that is, the same links are counted more than once. In an attempt to solve this problem of redundant sequences, Coleman (1964, pp. 447-448) devised a method which consists of separating each row vector rather than using the entire matrix, so that each person's connections are calculated separately. But as Coleman himself acknowledges, this alternative is only an approximation of what would be desirable. While the matrix multiplication procedure allows redundant sequences, Coleman's alternative procedure counts too few.

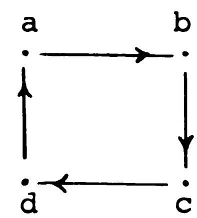
Ross and Harary (1952), and Parthasarathy (1964), offer alternative solutions to the problem of redundant sequences, but their formulas are quite formidable and there seems to be little likelihood that a general solution is practical by their method.

The Distance Matrix

Both the problem of multiclique membership and that of the determination of n-chains are partially overcome with the use of a distance matrix, defined as "The squared matrix of order 'p' whose entries are the distances d_{ij}," d_{ij} being the distance $d(a_j a_i)$ from a_j to a_i.

If there is no connection between a_i and a_j then $d_{ij} = 0$ (Harary and others, 1965, pp. 134-139). The distances in a graph, G, such as the one in Figure 3 (which is a hypothetical representation of the communication structure in a group of four persons) are not difficult to figure, and are shown in the distance matrix, DM:

G:



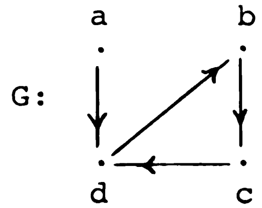
DM:

	a	b	c	d
a	0	1	2	3
b	3	0	1	2
c	2	3	0	1
d	1	2	3	0

Figure 3. Example of a Graph (G) with its Distance Matrix (DM).

Matrix DM presents two main features: (1) its major diagonal has only "0" entries, because the distance from every point (person) to itself in graph G is 0, and conversely; and (2) every one of its entries is finite. On the other hand, the entries of point (person) a in matrix DM, associated with graph G in Figure 4, are 0's, because a cannot be reached from any of the other three points (persons).

A distance matrix is constructed from a binary matrix (0-1), A, as follows: (1) enter 0's on the main diagonal of the distance matrix, DM, so that $d_{ii} = 0$; (2) enter 1 in the DM whenever $a_{ij} = 1$. For n-powers of



	a	b	c	d
a	0	2	3	1
b	0	0	1	2
c	0	2	0	1
d	0	1	2	0

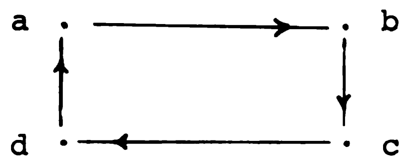
Figure 4. Example of a Graph (G) with its Distance Matrix (DM).

the binary matrix, A, enter n whenever $a_{ij}^{(n)} = 1$, and as long as there is no prior ij entry in the DM, so that $d_{ij} = n$. In case any cells remain open on the DM after the A^{n-1} power has been computed, the procedure is to enter 0's in all. These procedures are illustrated in Figure 5.

If matrix A, in Figure 5, were raised to the fourth power (A^n), all four cells on its main diagonal would be 1; consequently, all entries on the main diagonal of matrix DM^4 would be 4. However, we know beforehand that $d_{ii} = 0$. Thus, unless one is particularly interested in analyzing the lines that have the same first and second points (loops), or in other words, self-nomination in a sociometrically determined communication network, there is no need to go beyond the A^{n-1} power.

In addition to showing the communication patterns of one, two, or ... n-1 steps or chains, the distance matrix permits the computation of the communication domain

G:



$$A: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 1 & 0 & 0 \\ b & 0 & 0 & 1 & 0 \\ c & 0 & 0 & 0 & 1 \\ d & 1 & 0 & 0 & 0 \end{array} \qquad DM: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 1 & 0 & 0 \\ b & 0 & 0 & 1 & 0 \\ c & 0 & 0 & 0 & 1 \\ d & 1 & 0 & 0 & 0 \end{array}$$

$$A^2: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 0 & 1 & 0 \\ b & 0 & 0 & 0 & 1 \\ c & 1 & 0 & 0 & 0 \\ d & 0 & 1 & 0 & 0 \end{array} \qquad DM^2: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 1 & 2 & 0 \\ b & 0 & 0 & 1 & 2 \\ c & 2 & 0 & 0 & 1 \\ d & 1 & 2 & 0 & 0 \end{array}$$

$$A^3: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 0 & 0 & 1 \\ b & 1 & 0 & 0 & 0 \\ c & 0 & 1 & 0 & 0 \\ d & 0 & 0 & 1 & 0 \end{array} \qquad DM^3: \quad \begin{array}{c|cccc|} & a & b & c & d \\ \hline a & 0 & 1 & 2 & 3 \\ b & 3 & 0 & 1 & 2 \\ c & 2 & 3 & 0 & 1 \\ d & 1 & 2 & 3 & 0 \end{array}$$

Figure 5. Illustration of Computation Procedures for a Distance Matrix, DM, for Matrix A, A^2, A^3.

of each member of the communication system, on the basis of which other indices may be computed.

As may be recalled, the basic notion of counting and then averaging individual distances in a communication network originated with Bavelas' (1950) work. His method is, however, limited to small groups, in view of the labor involved.

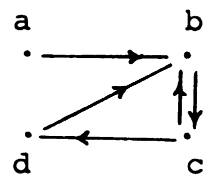
Computer programs designed to perform the operations described in the preceding discussion are now available. One version of such programs is offered by Lin (1968).

Lin's Program

The output of Lin's program provides a distance matrix, the influence domain, a centrality index, and a prestige index for each element in the matrix.

The influence domain of an individual is the number of persons with whom he is directly or indirectly connected. The centrality index is obtained by dividing the sum of the length of all links in *i*'s row or *j*'s column (in the distance matrix) by the respective influence domain. The prestige index is obtained by dividing the influence domain by the product of the centrality index and the number of other elements in the matrix (i.e., N-1). Figure 6 illustrates the basic procedures for the computation of these indices.

G:



	a	b	c	d
a	0	1	2	3
b	0	0	1	2
c	0	1	0	1
d	0	1	2	0
Σj	0	3	5	6

Influence domain	Centrality index	Prestige index
a_j = 0	0 = 0.0	0.0 = 0.0
b_j = 3 (a_i,c_i,d_i)	3/3 = 1.0	3/1.0(3) = 1.0
c_j = 3 (b_i,a_i,c_i)	5/3 = 1.6	3/1.6(3) = 0.6
d_j = 3 (c_i,b_i,a_i)	6/3 = 2.0	3/2.0(3) = 0.6

Figure 6. Illustration of the Basic Procedures for the Computation of the Influence Domain, Centrality, and the Prestige Index, by Nan Lin's Program.

Lin's procedures represent a considerable progress in the analysis of sociometric data. It has, however, some limitations. One of these limitations relates to the computation of the centrality and prestige indexes. As can be noticed in Figure 6, the centrality index reflects not j's (or i's) status relative to all the other network members, but his position in relation to those persons with whom j (or i) is directly and/or indirectly connected. Person d, for example, as represented in graph D, Figure 6, has only one direct connection (with person c), that is, assuming that the graph represents a choice pattern among the four persons represented in it. On the other hand, person b has three direct connections (all the other members of the network choose him). Yet d's centrality index is equal to 2.0 while b's is equal to 1.0. This means that the centrality index, as proposed by Lin, is not linear when the whole group is taken into consideration. It might be so if one is dealing only with subsets of individuals within a given network. And since the prestige index derives directly from the centrality index, both have limited applicability for certain types of analyses, as for example, when the major concern is to compare different network structures.

The Network Routine

An alternative routine has been programmed to overcome the problem pointed out in the preceding paragraph. The routine has been named "network routine" since it is intended as a computational device for the analysis of communication network structures. The main features of the network routine are:*

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*This program is a modified version of Nan Lin's program, and was prepared with the assistance of Anita Imelé and Betty Darlington, at the time, staff members in the Communication Research Services, of the Department of Communication of Michigan State University.

1. Input: Sociometric data, or similar type of data that can be reduced to a 0-1 matrix. The capability of the program is 400 subjects.

2. Output:

   (1) A list of each nominator, i, and his respective nominee(s), j.

   (2) A distance matrix, DM.

   (3) A reversed distance matrix, RDM. This is a square matrix showing in its cells (ij) the entries of the distance matrix, in inverted order. The cells which show the highest entries in DM are assigned the lowest values in RDM; the cells with the second-highest values in DM are assigned the second-lowest values in RDM, and so forth. The distance matrix, DM, shown in Figure 6, would have its cell values reversed as follows:

Distance matrix, DM	Reversed distance matrix, RDM
0	0
1	3
2	2
3	1

   The reversed distance matrix, RDM, is constructed in order to obtain an accurate measure of the relative integration (defined below) of each individual in the communication network, as indicated by the averaged number of all their direct and indirect links. The use of the distance matrix, DM, for the computation of this index would not correspond to each individual's actual position in the network, since a given person may have several relatively "high" scores in his column cells (j)--say 5, 4, 6, etc.--but be in actuality relatively "low" in integration within the network structure, since the cell values correspond to the number of steps through which a person is connected with the others in the network. By the same token, persons with relatively "low" values in their column cells (j)--say 1's and 2's--would be "low" in integration, when their scores are obtained from the distance matrix, DM. In reality, however, the persons with 1's and 2's in their column cells (j), in matrix DM, are relatively "higher" in integration, as measured in terms of direct and two-step contacts, than the persons with 5's and 6's, whose position may be only peripheral in the communication structure.

(4) The <u>communication domain</u> for each column <u>j</u>, and for each row <u>i</u>. This is j's (or i's) number of direct and indirect links in matrix DM.

(5) The <u>sum of the length of all links</u> in j's column and i's row.

(6) A <u>relative integration index</u> for each j's column (and for each i's row). This is the sum of the length of all links in j's column, or in i's row, in matrix RDM, divided by N-1 (the number of individuals in the matrix minus j, or i).

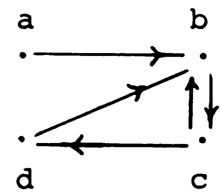
(7) A <u>network integration index</u>. This is the sum of j's or i's relative integration divided by N (the number of persons in the network).

(8) A list of <u>isolates</u> in the network, that is, persons who are not chosen or who do not choose any other member in the network.

Figure 7 illustrates the basic procedures for the computation of these indices.

As can be noticed in Figure 7, the <u>relative integration index provided in this alternative procedure reflects the position of each individual (j or i) in relation to all the other network members</u>, as opposed to <u>only</u> those with whom <u>j</u> (or <u>i</u>) is directly or indirectly

G:



DM:

	a	b	c	d
a	0	1	2	3
b	0	0	1	2
c	0	1	0	1
d	0	1	2	0
Σj	0	3	5	6

RDM:

	a	b	c	d
a	0	3	2	1
b	0	0	3	2
c	0	3	0	3
d	0	3	2	0
Σj	0	9	7	6

Subjects	Sum of Column j	Communication Domain, j	Relative Integration Index, j	Network Integration Index
a_j	0	0	0/3 = 0.0	
b_j	9	3	9/3 = 3.0	
c_j	7	3	7/3 = 2.3	
d_j	6	3	6/3 = 2.0	7.3/4 = 1.825

Figure 7. Illustration of the Basic Procedures for the Computation of Indices by the Network Routine.

connected. As such, this measure is appropriate for different analytical levels, ranging from individual roles, such as communication leaders, liaisons, or isolates, to the communication system as a whole, or its subsystems, such as cliques, and dyads.

In addition to enabling the investigator to trace the communication patterns in a network, from 1 to N-1 steps, the present routine can be used as a technique of data reduction, and as such, it allows the formation of indices of process variables, which in turn make possible, when dealing with communication data, a shift in the unit of analysis: From the individual to the entire systems.

CHAPTER IV

CONCEPTUAL FRAMEWORK

Introduction

The two preceding chapters represent a review and ordering of past research that has direct or indirect bearing on the comparative analysis of communication integration. We have seen that various research orientations contribute, both conceptually and methodologically, to the study of communication structures in various types of social systems. Our task now is to develop a meaningful framework that will constitute a conceptual basis for the analysis of communication integration in varying types of social systems. The following discussion is addressed to that task.

One idea pervading the models used in social and behavior studies is the use of General Systems Theory (GST) as a conceptual framework. According to Boulding (1956) "General Systems Theory is a name which has come into use to describe a level of theoretical model-building which lies somewhat between highly generalized constructions of pure mathematics and the specific theories of specialized disciplines."

GST then is not a theory in the sense that this term is generally used in science, but rather a "general science of wholeness" (von Bertalanffy, 1968, p. 37), or a "program or direction in the contemporary philosophy of science" (Rappoport, 1968). Given its wide spectrum, and the fact that GST is still in its formative stage, each of its many advocates, coming from diverse fields (e.g., mathematics, biology, engineering, social science) has his own definition of the field.

One board objective of GST is to seek integration of various research efforts through the development of better understanding of different entities called systems. In this sense, GST offers a panoramic perspective; that is, it emphasizes the notion of a whole having predominance over its parts.

Two major interrelated approaches to GST can be identified. One is usually associated with the work of von Bertalanffy (1956, 1962, and 1968), and is biological or organic in nature. The other is more mathematically oriented, and emphasizes structural analysis, that is, relations among parameters and among parts (e.g., Rappoport, 1966, 1968; Gordon, 1967; Deutsch, 1969).*

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*von Bertalanffy (1968, pp. 17-23 and 90) identifies the following trends in GST: "classical" systems theory, computerization and simulation, set theory, graph theory, net theory, cybernetics, information theory, theory of automata, game theory, decision theory, and queuing theory.

Application of General Systems Theory to Behavior and Social Sciences

GST by its holistic approach has forced the recognition of realities that appear in no other presepctive. It provides a useful framework for examining social and behavior phenomena. Because it can be utilized at different levels, GST allows also an integration of different research interests--from the individual (e.g., intrapersonal) to societal research.

The application of GST to behavior and social phenomena has two major lines of development:*

1. Miller (1955, 1965a, 1965b, 1965c, 1972), who identifies his approach as "general behavior systems theory."

2. Parsons (1951, 1953, 1959, 1968), who presents the "most fully developed systems approach" for the study of social systems (Katz and Kahn, 1966, pp. 8-9).

Miller (1965a) advocates the application of GST to all levels of science, from the study of a single cell to the study of groups, societies, and supranational systems. Following von Bertalanffy (1956), Miller (1965a) defines <u>system</u> as "A set of units with relationships among them." He identifies three major types of systems:

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*Katz and Kahn (1966, p. 8) believe that the work of Allport (1954, 1962), who developed a "structuronomic" view of individual and collective behavior, is similar in nature to that of general systems theorists.

1. Conceptual systems, which are those composed of idioms, numbers, or other symbols, such as those in computer simulation and programs.

2. Abstracted systems, which are relationships abstracted by an observer in the "light of his interests, theoretical viewpoint or philosophical bias" (Miller, 1965a).

3. Concrete systems, which refer to "nonrandom accumulation of matter-energy, in a region in physical space-time, nonrandomly organized into co-acting, interrelated subsystems or components" (Miller, 1965a).

Miller is primarily concerned with the latter type of systems, or with living systems, and hence, open systems.* He is particularly interested in the development

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*von Bertalanffy (1956, 1962, 1968) and other general systems theorists distinguish between closed and open systems, and between living and nonliving systems. A closed system admits no matter from external sources and is, therefore, subject to entropy (i.e., a law of thermodynamics according to which all forms of organization move toward disorganization or death). An open system is characterized by: (1) intake and output of both matter-energy and information transmission, (2) negative entropy, (3) steady (homeostatic) states, and (4) equifinality, i.e., "in contrast to equilibrium states in closed systems which are determined by initial conditions, the open system may attain a time-independent state independent of initial conditions and determined only by the system parameters" (von Bertalanffy, 1956). Living systems are (1) open systems, and (2) they maintain "a state of negentropy even though entropic changes occur in them as they do everywhere else" (Miller, 1965a). Concrete systems which do not have the characteristics of a living system are nonliving systems.

of generalizations that may hold at different systemic levels. He has defined (Miller, 1965b) seventeen critical subsystems which, he says, are essential to the life of any living system, whether cell or society. These seventeen subsystems are classified into two categories: matter-energy processing subsystems and information processing subsystems.*

Parsons' scheme has as its fundamental starting point the concept of social systems of action. A <u>social system of action</u> can be analyzed in terms of five inseparable elements: (1) an actor, (2) an objective or goal, (3) a set of norms, (4) a situation, and (5) a structure.

According to Parsons, all social action occurs in systems. A process which is initiated with behavior oriented toward a goal and ends with the attainment of that goal, is an <u>action cycle</u>; this action cycle occurs within a system of social action.

A <u>system of social action</u> is composed of three types of subsystems, each of which may be treated also as a system:

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*Matter-energy processing subsystems include: Ingestor, distributor, decomposer, producer, matter-energy storage, extruder, motor, and supporter. Information processing subsystems include: Input transducer, internal transducer, channel and net, decoder, associator, memory, decider, encoder, and output transducer.

1. The personality system of at least two actors, consisting of various types of motivations in relation to goals and behavior patterns.

2. The social system, or structure of the social organization, consisting of defined roles, and their internalized expectations.

3. The cultural system, consisting of the inheritance of knowledge, beliefs, ideas, customs, values, norms, with the symbols which represent them.

In some of his writings (e.g., 1968) Parsons refers also to the organism as a system, which would constitute the basis for the personality system.

None of the systems included in Parsons' scheme is entirely independent of the other; they are, rather, interpenetrating, but not mutually reducible. The social system, according to Parsons, is the core of human action systems, being the primary link between the culture and the individual, both as personality and as organism.

The Social System

Parsons considers the social system a theoretical system specifically adapted to describing and analyzing social interactions as a class of empirical systems. The social system is an open system engaged in the process of interchange (input-output relations) with its environment, as well as consisting of interchanges among its internal units or subsystems.

The inputs to a social system are the energies absorbed by the system or the information introduced in it. The outputs of a social system are those energies, information, or products that the components discharge from the system. The control of inputs as a function of outputs is achieved through a process called feedback.

System openness refers to the "degree to which the system is receptive to all types of inputs" (Katz and Kahn, 1966, p. 58). The concept of system openness is closely related to two other fundamental concepts in systems theory: System encoding and system boundaries.

System encoding is the "major procedure for ensuring specification for the intake of information and energy, and it thus describes the actual functioning of barriers separating the system from its environment" (Katz and Kahn, 1966, p. 58). Social systems develop their own mechanisms which regulate the acceptance or rejection of environmental (external) influences, as well as encoding of inputs.

System boundaries constitute the "lines or regions for the definition of appropriate system activity, for activity of members into the system, and for other imports into the system" (Katz and Kahn, 1966, p. 58). The boundary of a system, according to Miller (1972, p. 20), holds together the components which make up the system, protects them from the environmental stresses, and excludes or permits entry to various sorts of matter-energy and information.

The boundary of a social system is, in other words, that region separating that social system from other social systems. Social scientists usually think of norms of a social system as rules of conducts for its members. With this notion in mind, we may conceive of norms as equivalent of the filtering function of boundary for the social system. As Berrien (1968) suggests, the concept of boundary would thus apply to both input and output relations.

Levels of the Social System

Miller (1965a) conceives of the universe as a nesting of systems, that is, of systems within systems. Parsons (1951, 1968) also views social systems as hierarchically organized.* Function, Parsons argues, is the only basis on which a theoretical ordering of living systems, and therefore social systems, is possible. Following Riley (1963, p. 11), we might add, however, that the characterization of a given social system on any hierarchical level (e.g., supersystem, system, subsystem, sub-subsystem, etc.) depends also on the researcher's

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*Both Miller's and Parsons' thinking coincide with the hierarchical "principle" proposed by von Bertalanffy (1968), who says: "Living systems can be defined as hierarchically organized open systems. . . ."

design and interest, since systemic modes of analyses have much in common, irrespective of the particular level under examination.

Structural Aspects of the Social System

Miller (1965a) defines structure of a system as "the arrangement of its subsystems and components in three-dimensional space at a given moment in time." In his opinion, structure is used straightforwardly in the biological sciences (as defined), but in the social sciences "there is a confusion as to what it means" (Miller, 1965b).

For Parsons (1951), roles and role-clusters occupied by individual actors and collectivities are the fundamental structural components of a social system.

Role theorists generally make a distinction, however, between role behavior and role expectations. The former is the emitted behavior of an individual (output) made in response to the role expectations by others (their output serving as input for the individual).

Bales (1950), Thibaut and Kelley (1959), and others propose that the role expectations and behaviors of a social system may be classified under two major headings: Task and maintenance. These are essentially equivalent to signal and maintenance inputs as proposed by Clark and McFarland (1963), Gibson (1960), Miller (1965a, 1965b, 1965c), and Berrien (1968). Maintenance inputs are those which energize the system and make it ready to function, and signal inputs are those which provide the system with information to be processed (Berrien, 1968, pp. 26-27).

The number of possible roles an individual may perform, in the maintenance input category, is limited by his own values, skills, etc., as he moves from one subsystem to another, within a given social system. The role an individual assumes in any given system is determined also by the nature of the signal inputs, i.e., in one system an individual may be a receiver and execute directions, but in another he may be the originator or source of directions.

Many empirical investigations have shown that a social system develops a role structure commonly understood by all or nearly all members of the social system. The social system comes to expect certain specific behaviors from specific members. These behavior expectations are normatively defined. The norms of a social system, therefore, define the roles of its members and vice-versa.

As already defined, a social system is an aggregate of several subsystems; each subsystem comprises all the roles of all the individuals who participate in it; these roles are normatively defined. The structure of a social system, then, includes subsystems of various types, roles of various types (within the larger system and within

<u>the subsystems), and norms that govern the subsystems and roles, as well as the relationships among them</u>.

<u>Functional Aspects of the Social System</u>

The structure of a system, says Miller (1965a, 1965b), may remain relatively fixed over a long period of time or it may change from moment to moment, depending upon the characteristics of the process in the system.

<u>Process</u> is defined as "all change over time of matter-energy or information in a system. . . ." Process includes the "on-going function of a system . . . " (Miller, 1965a).

Miller is particularly concerned with the distinctions between structure and process (or function), arguing that these distinctions are not always made in the social sciences.

For Parsons (1968), functional aspects of any social system are those concerning the conditions of the maintenance and/or development of the interchanges with the environment, both input from it and output to it. For him, every social system must always solve four functional problems: (1) adaptation, (2) goal attainment, (3) integration, and (4) pattern maintenance and tension management.

Broadly speaking, the social structure of every social system does to some extent solve these problems;

if it did not, the system would cease to exist as an independent or distinct entity. The social structure "solves" these functional problems through input-output relations with environmental systems, and/or some form of exchange among the system's internal units or subsystems. A key factor--if not the key factor in this process is communication. Communication is, therefore, of vital importance in the functioning of any social system. "It may be presumed that disruption of the communication system of a society [social system] is ultimately just as dangerous as disruption of its system of order . . . " (Parsons, 1964, p. 33).

In fact, communication is looked upon as a basic process not only of social systems, but al all living systems. Thayer (1968, p. 17) conceives communication "As a dynamic process underlying the existence, growth, change, the behavior of all living system. . . ."

Communication and Communication Systems

Communication is a word so widely used that we usually take its meaning for granted. But "Communication is a good deal more talked about than understood" (Thayer, 1968, p. 12). An evidence of this assertion is the fact that there are probably as many definitions of communication as there are investigators interested in this area of research. The main problem here, however, is not to attempt to define a concept that in the context of systems theory would have to be defined de novo every time some class of entities (e.g., individuals, social systems, etc.) and relations among them are singled out for attention.

Communication is defined as a process of meaningful interaction by which persons exchange cognitions, affections, and actions through the use of symbols organized into messages. Communication should not be understood however, as merely an exchange of messages between a sender of messages and a receiver. Conceived in relation to the social system in which it occurs, and considering its function, communication becomes a special type of subsystem of the social system, or in a more general sense, a communication system.

Structural Components of Communication Systems

Communication as a system has its own structural and functional aspects. The structural aspects of a communication system are represented by its topological arrangement, and may include, for example:

1. Number and kinds of elements in the system, and their relationships.
2. Information media available.
3. Social, organizational, and physical distance among the system members (e.g., channel length).

The *functional aspects* of a communication system may include, for example:

1. Rates of message flow.

2. Proportion of messages received over the system network which contain relevant information for the receiver(s).

3. Information distortion, redundancy, etc.

The present study is limited to the structural aspects of communication systems. Taking a community as a referent, its communication system embraces various structural components or subsystems, as for example, cliques, chains, dyads, communication leaders, liaison persons, bridge contacts, and isolates.

A *clique* is a subsystem whose elements interact with each other relatively more often than with other members of the communication system.

A *chain* refers to *n* number of elements in a communication system who are interconnected, at a given point in time, through transitive relations (i.e., a --> b --> c -->d).

A *dyad* is a subsystem in which two elements are engaged in mutual (or symmetrical) interaction (i.e., a<--> b).

A communication leader is a person who is sought by other persons in the communication system with a relatively greater frequency than most other members.

A liaison person is an individual who interconnects two or more subsystems (i.e., cliques, dyads), and yet does not have a majority of his contacts in either.

A single bridge contact is an interconnection between two members of two different subsystems (e.g., cliques) which does not involve liaison persons.

A double bridge contact is defined as two different interconnections between two members of two different subsystems (e.g., cliques) which do not involve liaison persons.

An isolate is a person who neither seeks nor is sought by any member of the communication system.

Like the social system of which it is viewed as a subsystem, the communication system is also an aggregate of several subsystems. Each communication subsystem is in turn organized into other subsystems, and these subsystems have as their lowest-level units, communication roles or role systems.

Integration of Communication Systems

One of the basic problems of any communication system has to do with its integration. By integration of a communication system we mean the degree to which its structural components (subsystems and individual units) are interconnected into a whole.

A communication system will be integrated at a maximum level if all its subsystems and individual units are mutually interconnected by direct contacts. This is a rare event when dealing with relatively complex systems, such as communities. A system will be at a minimum level of integration when its subsystems and individual units have relatively few or no direct contact among themselves. An extreme lack of integration would be a system made up mostly of "separate" units. Another factor related to the degree of integration of a communication system is the relative frequency of indirect contacts. A system with a relatively large number of direct and indirect contacts will be relatively more integrated than a system with relatively few direct and indirect contacts, but less integrated, in relative terms, than a system in which all subsystems and individual units have direct, mutual contacts.

Communication integration is thus a variable that ranges on a continuum of "high" to "low," depending on the direct and indirect interconnections among the subsystems and system members.

Levels of Communication Integration

In general terms, the integration or lack of integration of a communication system involves at least two sets of structural components: (1) the patterns of interconnections exhibited by each system unit, in reference to each other and to each subsystem; and (2) the patterns of interconnections shown by the subsystems.

In order to make research on communication integration relevant to different levels of social system complexity, it is necessary to take into account the number of subsystems and individual units contained in a given system. The larger the number of its structural components, the more complex a system will tend to be.

In a relatively complex system, one may focus, for example, on the integration of the system as a whole (the integration of the "larger system"). Or one may be interested in analyzing the integration of a subsystem in itself. In the latter instance, emphasis would be on the relationships among the subsystem's own components.

At another analytical level, one may be interested in the relationships of the system as a whole (the "larger system") with its various subsystems and individual units. The extent to which the subsystems and individual units are integrated into the larger system constitutes as much a phase of the larger system integration as of the subsystem's integration.

As indicated elsewhere (Guimaraes, 1968, 1970), the degree of integration (or lack of integration) of a communication system can be viewed from at least two major perspectives: External (or extra-system) and internal (or intra-system). The external perspective has to do primarily with communication to the system, while the internal perspective refers to communication within the system.

The external (or extra-system) perspective refers to environmental or extrinsic inputs, that is, inputs from suprasystems and from the environment across the boundary of the communication system, which presumably may affect the system's internal structure, and consequently its functioning or information processing and outputs.

We have previously defined a social system as an open system engaged in a process of interchange (i.e., dynamic equilibrium) with its environment, as well as with its internal units or subsystems. As a special subsystem of the social system, a communication system is also an open system in a state of dynamic equilibrium with environmental inputs, as well as with its internal components. The environment of a communication system is made up in part of other communication systems, such as mass media, change agencies, and other such extrinsic input channels; and in part of individual persons whose roles are extra-system based.

The internal perspective of a communication system has to do primarily with its intrinsic components. These are the system's subsystems and individual units. They can be subsystems of institutionalized media that operate within the boundaries of the system, as well as subsystems of interpersonal relations.

The external and internal perspectives of a communication system may be closely interrelated. The extent of such a relationship is determined partly by the availability and actual in-flow of inputs from the environment (extrinsic channels) into the receiving system. On the other hand, the extrinsic inputs which a system will receive are also largely determined by the receiving system's intrinsic characteristics, such as its encoding mechanism, boundary control, degree of permeability, adaptability and openness, and so on. These characteristics are, in turn, directly related to a system's communication integration or lack of integration.

Level of Analysis in the Present Study

As indicated in the foregoing discussion, the analysis of communication integration is a "hierarchical" problem, ranging from the individual level to the macro-social level. Our main concern in the present study is with communication integration of community systems. Our analysis is then at the local social system level.

Our purpose is to compare several social systems in terms of their intrinsic communication integration, as measured by their subsystems of interpersonal relations.

To facilitate discussion, we shall use the term communication integration to refer to the integration of the system's interpersonal channels.

Another objective of the study is to relate communication integration with several communication and modernization variables. The anticipated relationships of communication integration with these variables is presented in the next chapter.

CHAPTER V

COMMUNICATION INTEGRATION IN MODERN AND IN TRADITIONAL SOCIAL SYSTEMS

Introduction

Modernization has been the focus of attention of anthropologists, sociologists, economists, political scientists, and lately, communication researchers. Each of these groups of social scientists has given primary emphasis to one or another specific aspect of the process, depending upon one's interest. As a result, the term has been variously defined. It is often equated with other processes of social change, such as industrialization, urbanization, or economic development.

Perhaps a most widely accepted view of *modernization* as a process, refers to the impact upon less developed, or relatively traditional societies, of exogenous forces originating in the relatively more advanced or industrialized societies. These external stimuli are in general not sufficiently powerful to provoke immediately significant structural changes in the receiving social system, but are generally strong enough to provoke psychic changes, and transformations in life styles and in levels of aspirations.

In this sense, a receiving social system which is relatively more open, or receptive, to these exogenous inputs, may be considered as relatively more modern than a receiving social system whose internal structure, encoding mechanism and boundary control, tend to limit the in-flow of these environmental inputs.

What this implies is that modern and traditional social systems differ with respect to their information processing mechanism, and consequently, with respect to their degree of communication integration. Indeed, the research literature reviewed in the present study yields some evidence to indicate that communication integration is positively related to modernization. Table 1 shows a summary of the main characteristics of modern and traditional social systems.

TABLE 1. Modern and Traditional Social Systems and Some of Their Salient Characteristics

Salient Characteristics	Social System	
	Modern	Traditional
Communication Integration	High	Low
Degree of Openness	High	Low
Boundary Control (structural limitations upon in-flow of environmental inputs)	Low	High
Encoding Mechanism (degree of reception, or search for, environmental inputs)	High	Low

A relatively well integrated communication system is more likely to perform effectively its role of information processing subsystem for the social system of which it is a part.

Communication Integration and Selected Modernization Variables

Several of the studies reviewed in the present paper have measured modernization in terms of *innovativeness*, defined as the degree to which an individual adopts new ideas relatively earlier than others in his social system. According to Rogers with Svenning (1969, pp. 291-292), there are various reasons to use innovativeness as a major indicator of modernization: "First it [innovativeness] offers a kind of 'hard data' about the extent to which modernization has occurred; ultimately, the degree to which an individual has accepted 'a more complex, technologically-advanced, and rapidly changing style of life' is best indicated by his actual use of new ideas in agriculture, health, and family living." Increasing an individual's rate of literacy, cosmopoliteness, and mass media exposure are designed, in the end, says Rogers, to encourage him to adopt a new way of life. "The best single indicator of his degree of modernization is innovativeness indicating a behavioral rather than a cognitive or attitudinal change."

One problem with the notion of measuring modernization in terms of innovativeness is that the latter concept is in itself multidimensional. So many variables appear to be important parts of the process of innovation, that it becomes a complex task to isolate the more significant ones. Rogers (1962, pp. 287-289) summarizes results of several studies conducted in the United States that used multiple correlation to examine the relationships of innovativeness with other variables. Some of the independent variables used in those studies are the following: Income, information contact, attitude toward change, mobility (cosmopoliteness), knowledge about innovativeness, education, etc. These independent variables explained from 17 to 64 per cent of the variance in innovativeness scores.

Since 1962, other investigations have been completed, nine of which are in less developed societies. Economic, attitudinal, communication, and group relationship variables are the most common independent variables that appear in these investigations. The explained variance in innovativeness in these studies ranges from 17 to 88 per cent (Rogers with Svenning, 1969, p. 301). Several of these variables that have been shown to correlate highly with innovativeness, and hence, modernization, were selected to be examined here in connection with communication integration.

One of the above mentioned variables that will be examined in the present study, with respect to communication integration is interpersonal trust, defined as an individual's attitude toward an ambiguous situation where the outcome involves uncertainty with respect to loss or gain, because such outcome is beyond the individual's control, and depend rather on another person(s).

Our argument is that a social system which shows a relatively high level of trust among its members is also likely to be relatively high in interpersonal contacts, hence the hypothesis:

Hypothesis 1: The higher the degree of interpersonal trust in a given social system, the higher the degree of communication integration.

Another variable that seems relevant for communication integration is opinion leadership, defined as the ability to influence other members of a social system in a consistent and desired way (Rogers with Svenning, 1969, p. 223). Opinion leadership in a given social system will tend to be highly concentrated if only a few individuals are influential. Under such conditions, interpersonal relations in the system as a whole are more likely to be hindered. Social systems characterized by low level of opinion leadership concentration, on the other hand, may offer greater opportunities for contacts, and thus, communication integration. The following hypothesis seems appropriate:

Hypothesis 2: The higher the degree of opinion leadership concentration in a given social system, the lower the degree of internal communication integration.

Social participation is another variable that appears to be relevant for communication integration. Social participation can be defined as the degree of an individual's involvement in the "social life" of his social system. Typical indicators of social participation are membership in formal organizations, attendance at social activities, informal visits with other community members, etc. Social participation is likely to widen the opportunities for social interaction, hence the utility of the concept as a predictor of internal communication integration. The following hypothesis seems in order:

Hypothesis 3: The higher the degree of social participation in a given social system, the higher the degree of communication integration.

Some studies of mass media exposure in relatively less developed communities (e.g., Rogers, 1966) show that there seems to exist an intercorrelation of exposure to various media, such as radio, newspapers, television, etc.

It appears reasonable, therefore, to use a single dimension (e.g., an index) of mass media as a predictor of internal communication integration. As a modernizing influence, the mass media may function to increase interpersonal contacts, thereby creating a positive relationship between the two variables.

Hypothesis 4: The higher the degree of mass media exposure in a given social system, the higher the degree of communication integration.

Cosmopoliteness refers to the degree to which individuals in a social system are oriented toward the external world, or the world outside their immediate social system. Cosmopoliteness is usually regarded as a modernizing force; as such, it tends to increase interpersonal contacts within the system.* Hence, the following hypothesis:

Hypothesis 5: The higher the degree of cosmopoliteness of a given social system, the higher its degree of communication integration.

One recognized objective of change agencies is to provide new information inputs to members of those social systems under their jurisdiction. The spread of new information in a given social system tends to accelerate

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*The concept of individual cosmopoliteness parallels that of system openness.

adoption of innovations, and ultimately, modernization. New information is more likely to have rapid dissemination in social systems characterized by relatively high levels of interpersonal contacts. The following hypothesis can be derived:

Hypothesis 6: The higher the degree of contacts with change agents, the higher the degree of communication integration.

The foregoing hypotheses constitute an integrated effort to analyze communication integration, at the aggregate level, and taking local social systems as the referent systems.

Our main interest in communication integration stems from its potential usefulness as a predictor of innovativeness, and hence, modernization. Results of an exploratory analysis of data from four Brazilian rural communities (Guimaraes, 1970) yield some indication that communication integration is indeed associated with innovativeness. The following hypothesis seems then in order:

Hypothesis 7: The higher the degree of communication integration in a given social system, the higher its degree of innovativeness.

The objective of this section was to review the literature on communication integration and provide for the derivation of hypotheses which can be transformed into empirical generalizations, and perhaps become the foundation for theories. The test of the utility of a concept such as communication integration lies in its potential for new research problems, as well as in its relation to old ones.

Table 2 shows the anticipated relationship of communication integration with the variables discussed. The basic notion is that interpersonal trust, opinion leadership concentration, mass media exposure, cosmopoliteness, and contact with change agencies, are some of the major factors correlated with communication integration, which in turn is positively correlated with innovativeness.

TABLE 2. Anticipated Relationship of Selected Variables with Communication Integration.

Variables	Anticipated Relationship with Communication Integration
Interpersonal Trust	Positive
Opinion Leadership Concentration	Negative
Social Participation	Positive
Mass Media Exposure	Positive
Cosmopoliteness	Positive
Contacts with Change Agency	Positive
Innovativeness	Positive

CHAPTER VI

METHODOLOGY

Source of Data

The data to be used in the present study were obtained in twenty communities in the State of Minas Gerais, Brazil. This sample of twenty communities was derived from an original selection of eighty communities initially included in Phase I of the "Diffusion of Innovations in Rural Societies" Project, sponsored by the United States Agency for International Development and carried out by the Department of Communication of Michigan State University. A description of the Project, which was conducted simultaneously in Brazil, India, and Nigeria, is provided in Rogers (1964), as well as in various other recent publications of the Department of Communication of Michigan State University. The most recent of these publications is a comparative report by Rogers and others (1970).

In brief, the original eighty communities were selected from a proportional stratified sample of forty <u>municipios</u> (counties) in which the agricultural extension agency of Minas Gerais, Association for Credit and Rural

Assistance (ACAR), had local offices. The local ACAR supervisors in each of these forty municipios were requested to designate the two communities, within their respective municipios, in which they had most and least success in their programs. This procedure resulted in a selection of eighty communities, forty "more successful," and forty "less successful," in which ACAR programs were being carried out for three years or more.*

A detailed discussion of the criteria that dictated the selection of the twenty communities included in Phase II of the Brazil study is found in Herzog and others (1968). In essence, they had to be suitable sites for the experiments to be carried out in Phase III of the Project. Since the Phase II experiments involved mainly literacy training and radio farm forums, the communities had to be within reach of a single broadcasting station, as well as have some pre-arranged place where the residents could meet to participate in one of the experimental treatments. Also, each community had to be easily accessible from Belo Horizonte, the state capital and Project headquarters, in view of the anticipated need to travel frequently to each community to carry out the treatments. Furthermore, half of the communities should be of "greater success" and half of "less success."

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*At the initial phase of the Brazil study, ACAR was operating in approximately 150 municipios of Minas Gerais.

These criteria determined the selection of eighteen communities, which would initially constitute the Phase II sample of the study. However, after the original eighteen communities had been selected, ACAR indicated to Project personnel its interest in having two additional communities included in the Phase II analysis. Both of these additional communities had been part of Phase I, and one of them had been classified as "more" and the other as "less" successful. Phase II sample was therefore increased to a total of twenty communities out of the eighty that had been initially selected for Phase I.

Table 3 shows a list of the twenty communities included in Phase II of the Brazil study, as well as the number of respondents interviewed in each of them.

Lists of residents in each of the twenty communities were made in advance, so that virtually all persons who were major farm decision-makers, for their respective households, and who owned at least part of the land they worked, were interviewed. Absentee owners were estimated at less than 5 per cent for most of the areas included in the study. A special effort was made to return to potential respondents who were not found at home in a first visit (Herzog and others, 1968).

TABLE 3. ACAR Local Offices and Phase II Communities of the Brazil Study, with Number of Respondents.

ACAR Local Office	Community	N
Tres Pontas	Porteira de Taboas**	35
Tres Coracoes	Abelhas**	61
Sao Joao de Nepomuceno	Rochedo de Minas**	67
Sao Joao del Rey	Arcangelo*	65
Santos Dumont	S. J. da Serra**	69
Bicas	Gameleira*	60
Rio Novo	Goiana*	69
Paraopeba	Picada**	82
Sete Lagoas	Fortuna de Minas*	75
Pedro Leopoldo	Matos*	60
Corinto	Curralinho de Dentro*	77
Cordisburgo	Periquito*	80
Itauna	Pedra**	74
Divinopolis	Quilombo*	56
Formiga	Albertos**	77
Uba	Corrego Alegre*	68
Cataguases	Itamarati*	70
Tocantins	Corrego do Meio**	54
Ponte Nova		45
Alvinopolis		63

**More successful
*Less successful

Brief Description of Minas Gerais, Brazil

Minas Gerais is a relatively large (larger than Texas) inland state of Brazil, occupying most of the land area between Sao Paulo, Rio de Janeiro, and Brasilia. The 1970 Census indicated a population of more than 13 million inhabitants. The capital city of Minas Gerais is Belo Horizonte, a sixty-year-old metropolis of more than 1 million people.

The Northern and Northeastern parts of Minas Gerais are characterized mostly by subsistence agriculture, with extensive beef cattle activities. The Southern and Southeastern regions are relatively more advanced in their agricultural and farm activities, presenting also a relatively higher level of industrialization and urbanization.

The Association for Credit and Rural Assistance (ACAR) of Minas Gerais is the oldest agriculture and home economics extension agency in Brazil. In its more than twenty years of activities, it has acquired a reputation, both in Brazil and in Latin America, as being a relatively successful organization. In addition to providing technical assistance to small and middle-size farmers and their families, through a state-wide program that emphasizes the diffusion of agricultural and home innovations, ACAR promotes a credit program designed to provide supervised loans to eligible farmers.

The selection of Minas Gerais as the site of the Diffusion Project was largely determined by ACAR's reputation as a well-established agency. Another factor that favored Minas Gerais, in comparison to other regions in Brazil and Latin America, was the fact that the Minas Gerais farmer was considered as fairly representative of the Brazilian farmer as a whole--being, in general, a type between the peasant of the Northeast and the more technologically oriented, commercialized farmer of the South (Herzog and others, 1968).

Instrument Construction, Data Gathering, and Processing

Phase II data were obtained through an interview schedule encompassing some thirty conceptual areas, which included several social psychological variables, such as aspirations, satisfaction, empathy, interpersonal trust; various communication variables such as mass media exposure, interpersonal contacts, physical mobility, contact with change agents, media credibility; and socioeconomic variables such as use of credit, credit orientation, education, political and educational knowledge, social participation, status, etc.*

*As indicated in Herzog and others (1968, Appendix B), the Phase II interview II schedule evolved out of more than two years of planning at Michigan State University, and by the Project personnel in Brazil. Two basic documents constitute the basis of this schedule. One is the "Revised Operational Plan" (1965) of the AID-MSU Diffusion Project in Rural Societies, and the other is Working Paper No. 17

The interview schedule was first pre-tested with a small group of respondents, revised, and then used in a pilot study involving fifty-five respondents outside the sample communities. The results of this pilot study were used to reorganize and improve the final data-gathering instrument.

Interviewers who had performed well in Phase I of the study--carried out several months prior to Phase II--were used as team supervisors in Phase II. In all, there were six teams, each consisting of three interviewers and one supervisor. These six teams were subject to intensive training prior to their data-gathering activities. The actual field work was carried out in six weeks.

In an effort to obtain reliability checks, supervisors validated 10 per cent of the interviews performed by their team members. In addition, each supervisor interviewed a small random sample of each community's respondents. Furthermore, interview schedules were edited in the field, on a daily basis.

Data were coded by Project personnel in Belo Horizonte, and forwarded to Michigan State University, where they were transferred to IBM cards. Error checking

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(Keith and Rogers, 1966), in which several conceptual areas, their measurement and analysis are examined.

was performed both through frequency counting and through specially designed computer programs.*

Operationalization of the Variables and Techniques of Measurement

The central focus of the present study is on the relationships of communication integration, within modern and traditional social systems, with several other communication, sociopsychological, and socioeconomic variables. The following discussion describes how each of these variables was operationalized. The discussion, which is presented in the same order in which the hypotheses were outlined, includes also illustrations of the techniques used in index construction.

Communication Integration

Communication integration of a social system has been defined as the degree to which its subsystems and individual units are structurally interconnected, through interpersonal channels. As indicated elsewhere (Guimaraes, 1970), sociometric questions have often been used to measure interaction patterns and interpersonal communication structures in social systems. One specific type of structural relations dealt with in Phase II of the Brazil study was based on the following question:

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*The author of the present thesis participated in some of the planning stages and in the field work of Phase I, and in the processing and analysis of Phases I, II, and III, of the Diffusion Project, as a research fellow in the Department of Communication of Michigan State University.

"Who are your three best friends with whom you talk most frequently?"

Communication integration is therefore measured by the sociometric choices received by the system members on a criterion explicitly concerned with interpersonal communication among friends.

The data obtained in response to the question above were fed into the network routine, whose main features were presented in Chapter III. As shown in that discussion, this routine provides an index of the network's integration, which is derived from the relative integration of each member in the communication structure. The output of this routine also provides a distance matrix, the communication domain for each system's member, and the number of isolates in the network.

Interpersonal Trust

Interpersonal trust has been defined as an attitude towards an ambiguous situation whose outcome depends on other persons, and therefore involves uncertainty with respect to possible gain or possible loss (Stanfield, 1968).

The following items were used in Phase II to measure interpersonal trust:

1. What do you consider best when it comes to dealing with your neighbors: Trust or trusting them but at the same time doubting them?

2. Do you think that the majority of men are naturally dishonest or honest?

3. One can trust the majority of people (agree or disagree).

The first of the above items was designed to measure trust of one's neighbors, and the second, although intended to measure trust at a more general level, was most probably interpreted by respondents as referring also to neighbors, since the two items appeared sequentially in the interview schedule.

Item 3 came much later in the data-gathering instrument, and was intended to measure trust of people in general.

An index of interpersonal trust was constructed for each respondent, by averaging the raw scores of these three items. Mean values were calculated for each community on the basis of the individual mean scores.*

Opinion Leadership Concentration

Opinion leadership, defined as the ability to influence other members of a social system in a consistent and desired way, was measured in Phase II of the Brazil

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*This index is essentially similar to the one used by Stanfield (1968) in his study of interpersonal trust and modernization, with the same population but his analysis is at the individual level rather than at the system level.

study through four questions. The first of these four questions attempted to measure influence in general information about agriculture. The other three questions measured influence in reference to three specially selected agricultural innovations.

The number of choices received by each person interviewed, in response to these four questions, constitutes each individual's leadership score.

Opinion leadership concentration is defined as the degree to which one or more individuals in a social system have a relatively greater degree of influence with respect to general information about agriculture, and with respect to the three innovations included in the study, as indicated in the foregoing discussion.

From a communication point of view, concentration of opinion leadership means that the availability of interpersonal influence channels is restricted in a social system.

Opinion leadership concentration for a given social system can be measured by the Gini index of concentration, calculated from the Lorenz curve.* The Lorenz curve is drawn by rank-ordering individuals according to the percentage of sociometric choices they receive. Both axes (OX, OY) of the lines shown in Figure 8 represent

*The above discussion is based on a memo to Diffusion Project personnel, dated November 7, 1966. Another reference on the topic is Wunderlich (1958).

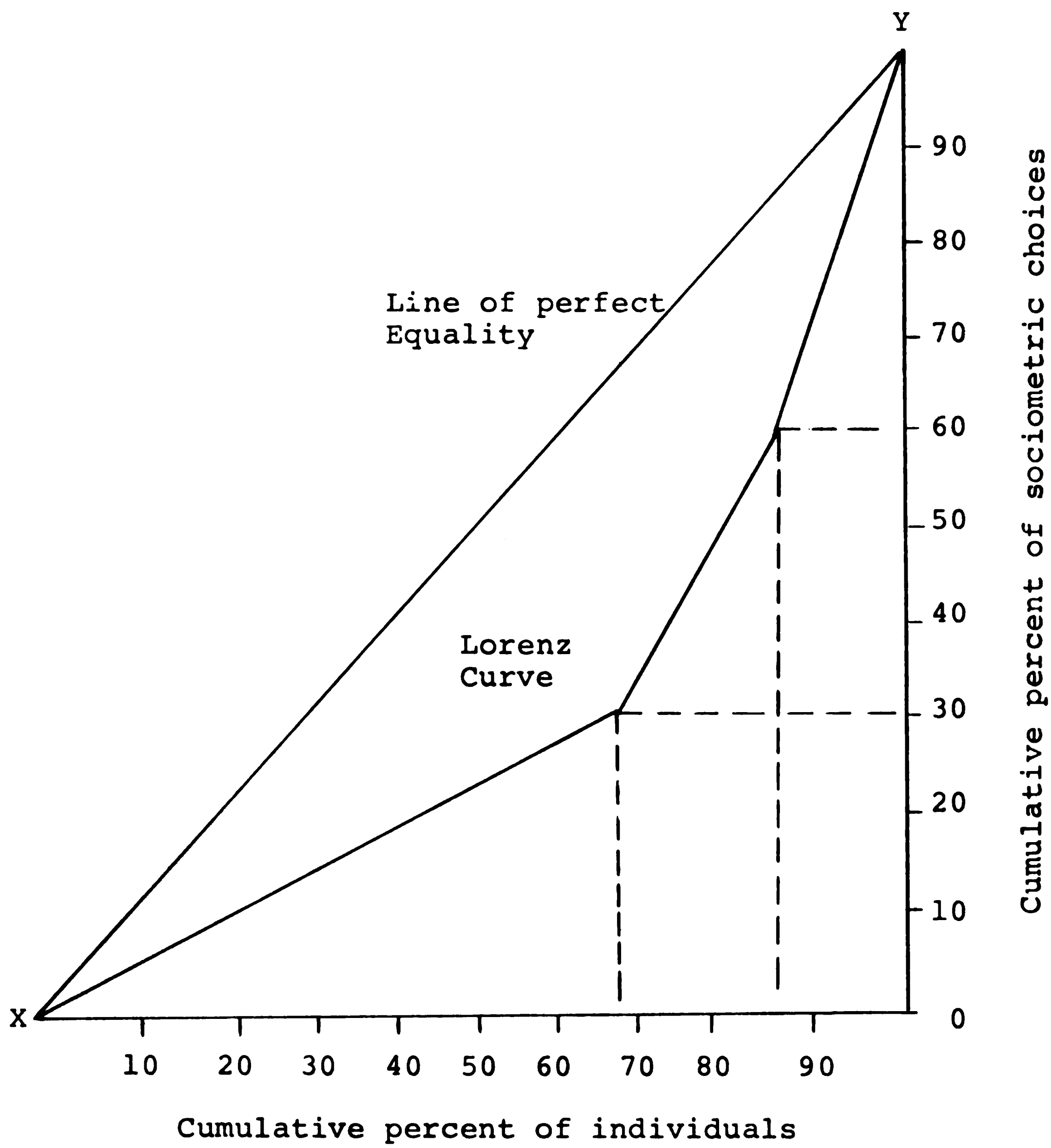

Figure 8. An Illustration of the Lorenz Curve.

cumulative percentage distributions ranging from 0 to 100. The distribution on the axis of the ordinate (OY) represents sociometric choices, and the distribution on the axis of the abscissa (OX) represents individuals. The straight line (XY) represents the line of perfect equality of distribution of sociometric choices among all individuals in the social system.

Assuming that in a given social system, 70 per cent of the members receive 30 per cent of the total number of sociometric nominations, and 60 per cent of the total number of choices are concentrated among 10 per cent of the members, a Lorenz curve to represent these sociometric relationships would be similar to the one illustrated in Figure 8. The area between the Lorenz curve and the line of perfect equality represents the degree of opinion leadership concentration.

The Gini index of concentration, or Gini ratio, is calculated as follows:

$$\text{Gini ratio} = \frac{\text{Area between the Lorenz curve and the line of perfect equality}}{\text{Total area of the triangle formed by the two axes (OX, OY) and the line of perfect equality}}$$

The Gini ratio "sums for each individual in the population, the difference between where he is on the Lorenz curve and where he would be expected to be in the case of equal distribution of sociometric choices among all the members" (Yadav, 1967, p. 102). This sum is divided by its maximum possible value so that the Gini ratio ranges from 0 to 1. The greater the deviation of the Lorenz curve from the line of perfect euqality, the greater is the concentration.*

Social Participation

Social participation has been defined as the degree of an individual's involvement in the "social life" of his social system. Social participation was measured in Phase II of the Brazil study, by asking respondents the number of formal organizations to which they belonged. These organizations include clubs, societies, cooperatives, etc.

An organization participation index was constructed by averaging the percentage of non-zero responses (responses were coded on a "0 to 9" scale), for each community.

Mass Media Exposure

Mass media exposure is defined as exposure to impersonal communication media. The indicators of exposure to mass media used in the present study are frequency of exposure to newspapers, magazines, radio, and TV. An index of mass media exposure, for each community, was

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*A computer program for the computation of the Gini ratio is filed at the Department of Communication Research Services, Michigan State University.

constructed by averaging the percent of exposure for each medium, and then calculating the mean for the three media.

Cosmopoliteness

Cosmopoliteness refers to the degree to which individuals in a given social system are oriented toward the external world, or the world outside their social system. The indicator of cosmopoliteness used in the present study is the number of visits to a large city in the past year. Gini-ratios were constructed for this item, for each of the twenty communities.*

Contacts with Change Agents

Contacts with change agents were measured as the frequency of interaction with the ACAR supervisor in the past year. Gini-ratios for this variable were constructed, for each of the twenty communities.

Innovativeness

Innovativeness has been defined as the degree to which an individual is relatively earlier than others in his social system to adopt a new idea. An innovativeness score was constructed based on the time of adoption of a

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*Working with a subsample of the twenty communities analyzed in the present study, Quesada (1970) found that visits to large cities was the best single indicator of cosmopoliteness, as compared with other items (e.g., having relatives in large cities, having lived away from own community, etc.).

series of up to twelve innovations, especially relevant for each community. Respondents were asked whether they had ever heard about the innovation, if they had adopted it, and the "number of years ago" they had started using it. The number of years ago that each respondent had adopted each innovation was added, and the total was divided by the number of innovations in the innovativeness scale for a particular community. The following is an example of how individual innovativeness scores were computed: Assuming that twelve innovations were included in the innovativeness score for community X, and that farmer F adopted four innovations, respectively, five, three, four, and six years ago, his innovativeness score would be:*

$$\frac{5 + 3 + 4 + 6}{12} = 1.5$$

*As indicated in Herzog and others (1968, p. 94), an alternative innovativeness score was calculated by standardizing the total number of years for each farmer across the practices. The innovativeness scores correlated highly with each other (r = 0.86).

CHAPTER VII

FINDINGS AND DISCUSSION

Introduction

This chapter describes the results of the study. It is organized into three major parts. Part one focuses on the index of communication integration used in the present study; part two examines some aspects of the validation of this index; and part three analyzes the relationships of communication integration and selected variables, as proposed in Chapter V.

A Measure of Communication Integration

As already pointed out, one of the limitations of the early studies on communication networks was the lack of methodological procedures that would allow quantitative analysis, in a manageable form, of data obtained in relatively larger and complex systems, such as communities and formal organizations.

The sociogram, and the sociomatrix, constituted useful but merely descriptive devices in this type of research. With the use of binary (0-1) matrices it became possible to develop more sophisticated procedures, that eventually led to the use of matrix algebra, particularly matrix multiplication and addition, for the detection of certain key structural aspects of communication networks.

Matrix multiplication poses, however, its own limitations, especially when one is interested in the identification of cliques, n-chains of direct and indirect connections, and so forth. The use of graph-theoretical concepts, associated with matrix algebra, can help in the solution of some of the difficulties, as indicated in Chapter III. This is basically what has been attempted in the present study, that is, the application of basic notions of graph theory and matrix algebra in the solution of some of the problems of structural analysis of relatively large communication systems.

A computerized routine ("network program") was developed and used to construct a distance matrix of all sociometric choices obtained in each of twenty communities of Minas Gerais, Brazil. The distance matrix, as already defined, is a squared matrix of order "p" whose entires are the distances d_{ij}, d_{ij} being the distance $d(a_j a_i)$ from a_j to a_i. The distance matrix allows a visual analysis--considerably better than a sociogram--of each communication network in terms of all direct and indirect linkages among the network's members.

A reversed distance matrix is also provided by the network program. This has been defined as a square matrix showing in its cells (ij) the entries of the distance matrix, in inverted order. The reversed distance matrix is constructed in order to obtain an accurate measure of the relative integration of each individual in the communication network.

The relative integration of each person in the network is defined as the sum of the length of all links in j's column (or i's row), in the reversed distance matrix, divided by N-1 (the number of individuals in the network minus j or i).

As previously pointed out (Chapter III), the use of the distance matrix for the computation of the relative integration index for each network member would not represent the actual position of each individual in the network, relatively to all the other members, since a given person may have several relatively "high" scores in his column cells (j)--say, 5, 4, 6--but be in actuality relatively "low" in integration within the network structure, since the cells values correspond to the number of steps through which a person is connected with the others in the system. By the same token, persons with relatively "low" values in their column cells (j)--say, 1's and 2's--would be "low" in integration, when their scores are obtained from the distance matrix. In reality, however, the persons with 1's and 2's in their column cells (j), in the distance matrix, are relatively higher in integration, as measured in terms of <u>direct</u> and <u>two-step</u> connections, than the persons with 4's, 5's, or 6's, whose position may be only peripheral in the community structure.

As pointed out in Chapter V, by <u>integration of a communication system</u> we mean the degree to which the system's structural components (subsystems and individual units) are interconnected into a whole, through interpersonal channels. In operational terms, a system's integration is defined as the sum of j's (or i's) relative integration divided by N (the number of persons in the network).

The communication integration of a given system is therefore a continuous variable, that ranges from "high" to "low," depending on the direct and indirect interconnections among the subsystems and the system members, or individual units.

A communication system will be integrated at a maximum level if all its subsystems and individual units are mutually interconnected by <u>direct</u> one-step connections. A system will be at a minimum level of integration if its subsystems and individual units have relatively few or no <u>direct</u> connections among themselves. Another factor related to a system's degree of communication integration is the relative frequency of its <u>indirect</u> (two to n-step) connections. A system with a relatively large number of <u>direct</u> and <u>indirect</u> contacts will be relatively more integrated than a system with relatively few direct and indirect contacts, but less integrated, in relative terms, than a system in which all subsystem and individual units have direct contacts.

Table 4 shows the communication integration scores for each of the twenty Minas Gerais communities, by rank order. These scores range from a low of 0.08, for community 51, to a high of 1.63 for community 20. The mean communication integration score for the twenty communities was 0.59. The number of respondents for each community is also shown in the table.

Validity of the Measure of Communication Integration

One of the major preoccupations of a researcher is to ascertain validation for his measurement instruments and indices. In a relatively new field, such as communication research, it seems natural, however, that the development of measurement techniques constitutes a primary need in itself, with some inevitable sacrifice of validation. As measurement techniques become more and more refined, more appropriate criteria of validity will be also developed.

In order to ascertain some degree of validity for the major indicator of communication integration used in the present study, some other indicants of communication integration were determined. These indicants and

TABLE 4. Communication Integration Scores for Twenty Communities of Minas Gerais, Brazil, by Rank Order, with Number of Respondents (N) for Each Community.

Rank Order	Community	Number of Respondents (N)	Communication Integration Scores
1	20	67	1.63
2	71	70	1.44
3	10	35	1.40
4	21	65	1.10
5	82	63	0.99
6	32	60	0.80
7	43	56	0.72
8	34	77	0.62
9	42	74	0.48
10	23	60	0.46
11	30	82	0.37
12	35	80	0.33
13	22	69	0.32
14	11	61	0.31
15	72	54	0.26
16	70	68	0.21
17	24	69	0.16
18	80	45	0.13
19	31	75	0.13
20	51	77	0.08

their correlations with our main measure of communication integration are discussed below.

Integration Through Direct Links

One crude measure of a system's integration is its degree of direct, one-step connections between pairs of individuals. An index of this nature can be computed on the basis of the proportion of all one-step links, to all possible. In a situation with an unlimited number of choices, the number of all possible choices would be N(N-1), that is, assuming that no self-choices would be allowed. A network index can then be computed by using the formula

$$\text{Integration through direct links} = \frac{\Sigma\, a_{ij}}{N(N-1)}$$

where $\Sigma\, a_{ij}$ = the sum of all the choices made by the network members.

In our particular case, however, respondents were limited to three choices. The formula for the computation of our index of one-step integration becomes then

$$\text{Integration through direct links} = \frac{\Sigma\, a_{ij}}{3(N)}$$

One-, Two-, and Three-Step Links

Another indicator of a communication network's integration (or lack of it) is the network's pattern of one-, two-, and three-step links. An index of this nature was computed for each of the twenty communities on the basis of the average number of all one-, two-, and three-step connections. The formula to compute this index is

$$\frac{\Sigma_i \text{ 1,2,3-step links}}{N}$$

This measure may seem somewhat similar to our major index of communication integration; it is however different because here we are merely counting the number of one-, two-, and three-step connections that appear in the distance matrix, while our indicator of communication integration is derived from the sum of the length of each individual's column in the reversed distance matrix.

Communication Domain

Communication domain has been defined as j's (or i's) number of direct and indirect connections in the distance matrix. Since this is an individual-level measure, an average communication domain for each community was computed, on the basis of the individual scores. This represents also a crude indicator of the degree of integration (or lack of it) of a communication system. The formula for this index is

$$\frac{\Sigma \text{ j Communication domain}}{N}$$

Dyadic Links

Another indicator of a system's integration (or lack of it) is its proportion of dyadic (reciprocated) links to the total number of possible dyads. In a situation with unlimited number of choices, the maximum number of possible dyadic relations is computed by the formula

$$\text{Dyadic Integration} = \frac{\Sigma(i \longleftrightarrow j)}{N(N-1)/2}$$

where $\Sigma(i \longleftrightarrow j)$ represents the sum of all dyadic relations, and $N(N-1)/2$ = the total number of possible pairs.

As already indicated, however, our respondents were limited in their nominations to three other individuals. Thus the formula for the computation of this measure becomes

$$\text{Dyadic Integration} = \frac{\Sigma(i \longleftrightarrow j)}{3(N)/2}$$

Table 5 summarizes the results obtained in each community for each of these indicators of communication integration. One can observe, for example, that community number 20, which had the highest score in our major index of communication integration, was the third highest on the one-step integration score, the second highest in the one-, two-, and three-step index, and the first on the communication domain indicator, but

TABLE 5. Communication Integration Index and Other Indicators of Communication Integration for Twenty Communities of Minas Gerais, Brazil.

Community by Rank Order	Communic. Integr. Index by Rank Order	Proportion of Direct Links	Average No. of 1,2,3-Step Links	Average Communic. Domain	Proportion of Dyads
1. 20	1.63	0.53	6.30	11.86	0.08
2. 71	1.44	0.36	2.20	2.44	0.03
3. 10	1.40	0.66	8.60	10.71	0.13
4. 21	1.10	0.42	4.32	10.04	0.08
5. 82	0.99	0.48	4.70	8.11	0.03
6. 32	0.80	0.46	4.40	6.82	0.08
7. 43	0.72	0.51	5.11	5.78	0.15
8. 34	0.62	0.41	3.58	7.53	0.03
9. 42	0.48	0.45	3.31	5.54	0.07
10. 23	0.46	0.44	3.13	4.37	0.13
11. 30	0.37	0.37	2.13	5.21	0.06
12. 35	0.33	0.33	3.20	3.89	0.08
13. 22	0.32	0.27	2.49	3.54	0.07
14. 11	0.31	0.37	3.24	4.03	0.09
15. 72	0.26	0.46	3.24	3.44	0.10
16. 70	0.21	0.36	2.56	2.76	0.05
17. 24	0.16	0.41	2.42	2.51	0.04
18. 80	0.13	0.30	1.71	1.73	0.04
19. 31	0.13	0.35	2.17	2.36	0.05
20. 51	0.08	0.22	1.25	1.41	0.02

only the sixth in the dyadic links index. Community number 51, on the other hand, is the lowest in all five indexes.

A Kendal coefficient of concordance, W, was computed for these five measures of integration, and the agreement among them is expressed by

$$W = .75$$

with $p < .001$.* It is possible to conclude, therefore, that these measures are related to each other. Although some of them are somewhat crude indicators, they lend some degree of validation to our index of communication integration.

Isolates

Isolates have been defined as those individuals who neither chose nor are chosen by any of the others in his social system. The percentage of isolates was calculated for each community. Those communities with a relatively higher proportion of isolates should be relatively low in integration, and vice versa. Table 6 shows this measure for each of the twenty communities. As one can see, communities number 22 and number 51 had the highest

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*No correction for tied observations was used for two reasons: (1) the proportion of ties was small, and (2) since the proportion of tied ranks is to depress the value of W, a larger value for W would not have changed our conclusion because the value of W obtained is already significant at the .001 level (see Siegel, 1956).

TABLE 6. Communication Integration Index and Percentage of Isolates for Twenty Communities of Minas Gerais, Brazil.

Community by Rank Order		Communication Integration Index	Percent of Isolates
1.	20	1.63	11.9
2.	71	1.44	21.4
3.	10	1.40	11.4
4.	21	1.10	13.8
5.	82	0.99	9.5
6.	32	0.80	11.7
7.	43	0.72	14.9
8.	34	0.62	19.5
9.	42	0.48	13.5
10.	23	0.46	10.0
11.	30	0.37	13.4
12.	35	0.33	20.0
13.	22	0.32	40.6
14.	11	0.31	23.0
15.	72	0.26	11.1
16.	70	0.21	20.6
17.	24	0.16	15.9
18.	80	0.13	26.7
19.	31	0.13	21.3
20.	51	0.08	40.3

percentage of isolates. Community number 22 was relatively low in the integration index, and community number 51, as already indicated, had the lowest integration score, as well as the lowest score in the other four measures of integration discussed in the preceding section.

The zero-order correlation coefficient (r) was computed for the average communication integration scores and percent of isolates. As anticipated, a high negative correlation (-.45), significantly different from zero at the .05 level, was found for these two variables, providing therefore an additional cirterion of validation for our index of communication integration.

Other Possible Indicants of Communication Integration

Other possible indicants of the degree of integration (or lack of it) of a communication structure would be its tendency toward clique formation, liaisonness, and other articulating points such as single and double bridges.

A *clique* has been defined as a subsystem whose elements interact with each other relatively more frequently than with other members of the communication system.

A *liaison person* is an individual who interlinks two or more subsystems (i.e., cliques, dyads), and yet does not have a majority of his contacts in either.

A single bridge contact is a linkage between two members of two different subsystems (e.g., cliques) which does not involve liaison persons.

A double bridge contact is defined as two different interconnections between two members of two different subsystems (e.g., cliques) which does not involve liaison persons.

In his study of two Indian villages, Yadav (1967) found that the more modern village had a relatively larger number of liaison persons than the more traditional village. It might have been expected that this would also be the case for the present data. Yet the more integrated communities had practically no liaison persons, which may be explained by the fact that almost everyone in the relatively more integrated communities was connected with everyone else, while the relatively less integrated structures allowed for some subsystem formation and thus, some degree of liaisonness.

It might have been expected also that a community with tendencies toward clique formation would have a relatively less integrated communication structure than a community whose members were mostly interconnected. The relatively less integrated communities had, in fact, more cliques as compared to the relatively more integrated ones. The number of cliques in these communities was, however, negligible to be used as a meaningful index of integration.

None of the communication networks analyzed had linkages that could be neatly identified as bridges. Again, this might be due to the nature of the data, and perhaps more so, of the systems being studied. As pointed out in Chapter III, most of the studies focusing on liaisonness and bridges, have been conducted in formal organizational settings, where some of these structural properties are perhaps more easily developed.

Had the respondents been asked unlimited sociometric choices, and if these choices had been also about other communication related issues (and not only about friendship relations), such as information seeking, it is probable that different communication structures would have emerged, perhaps with more differentiation with respect to cliques, bridges, and liaisons.

On the other hand, farming communities, such as the ones studied here, because they are less characterized by institution-based subdivisions, could be less amenable to the development and maintenance of structural linkages such as those generally attributed to liaisons and bridges.

One variable that could be related to these structural aspects is <u>size</u> of the communication network. Size would have two major dimensions: one is expressed by the number of people included in the network (in our case, the number of respondents, which represents roughly a census of each community household); the other dimension would be the community settling problem, or its "geographical size."

With respect to the first dimension of size, that is, the number of community members, it shows a positive correlation of .42 (significantly different from zero at the .05 level) with communication integration scores. It appears that the larger communities are relatively more integrated than the smaller ones. This finding is not in agreement with results generally obtained for small groups, as reported in Chapters II and III. As we may recall, one general conclusion drawn from small group studies is that smaller groups tend to be more conducive to communication integration than larger ones.

Unfortunately, we have no data that would allow us to determine a possible relationship of the "geographical size" of a community and its structural properties. On a purely speculative basis, one might expect that the communities which are geographically larger would tend to exhibit a relatively lower degree of communication integration than those located in a relatively smaller geographical setting.

Testing the Hypotheses

Several variables that have been found to correlate with modernization were selected for examination here as possible predictors of communication integration. The correlations of each of these variables with communication integration will be examined next. The zero-order correlation coefficient (r) will be the statistic used to test the hypotheses, and the level of significance for acceptance or rejection of hypotheses will be .05.

Interpersonal Trust

Interpersonal trust has been defined as an individual's attitude toward an ambiguous situation where the outcome involves uncertainty with respect to loss or gain, because such outcome is beyond the individual's control, and depends rather on another person(s) (Stanfield, 1968).

Hypothesis 1 was formulated as follows: The higher the degree of interpersonal trust in a given social system, the higher the degree of communication integration.

An index of interpersonal trust was constructed for each community, on the basis of individual scores on three "trust" items. These items attempted to measure trust in neighbors, trust in the majority of people, and belief in basic honesty of people. The zero-order correlation (r) of the total trust index and communication integration was, however, negative (-.03).

To explore further the relationship of interpersonal trust and communication integration, zero-order correlations were also computed for each of the trust items that formed the total trust index. The results of these three correlations, as well as the correlation of total trust with communication integration, are shown in Table 7.

TABLE 7. Correlation between Trust Items, Total Trust, and Communication Integration in Twenty Communities of Minas Gerais, Brazil.

Trust	Correlation (r) with Communication Integration
1. Trust in neighbors	-.01
2. Trust in majority of people	.10
3. Belief in basic honesty of people	-.05
4. Total trust (mean of three items)	-.02

On the basis of these results, the prediction that interpersonal trust would be positively related to communication integration, is not supported. The only trust item that correlates positively with communication integration is "trust in majority of people," yet as shown in Table 7, the correlation is relatively low, and not significantly different from zero at the .05 level. The other items all correlate negatively with communication integration, although these correlations are also relatively low.

The hypothesis that interpersonal trust would be positively correlated with communication integration was based on the reasoning that a social system which shows a relatively high level of trust among its members is also likely to be relatively high in interpersonal contacts. It appears then that at least for the data analyzed, this may not necessarily be so. One speculative explanation for these findings is that interpersonal relations might not necessarily depend on mutual trust, since the former may be structured on the basis of some goal-directed actions rather than on mutual feelings of trustworthiness among the community members.

Another possible explanation for the results yielded by the data is that the items utilized did not necessarily measure what they were designed to measure. Test-retest reliability of various measures used in Phase II of the Brazil diffusion study, shows that the three trust items used here had a reliability coefficient of .40 (trust in neighbors), .36 (belief in basic honesty of people), and .21 (trust in majority of people). These reliability coefficients are the zero-order correlation coefficients (r) between the responses that an individual gave in Phase II with those he gave in Phase 2.5. These correlations are significantly different from zero at the .01 level, with a sample of 315 respondents.*

It should be pointed out, however, this test-retest reliability, although adequate to verify the extent to which respondents were consistent in answering the same questions, on two different occasions, was not a validity test for the items utilized to measure interpersonal trust. As indicated in Kerlinger (1964, pp. 444-445), "the most commonest definition of validity is epitomized by the question: Are we measuring what we think we are measuring?" A question remains, therefore, of whether the items utilized actually measured interpersonal trust.

Working with the total sample of Phase II data (1,307 respondents), Stanfield (1968) found that interpersonal trust correlates negatively with several indicants of the modernization process, like innovativeness, education, mass media exposure, and trips to a city. "This result," says Stanfield, "forced a reinterpretation of the theory linking trust and social change, changing from an absolutist expectation of more development, more

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*A total of fifty-six items that were measured in Phase II were repeated one year later with a subsample of 315 respondents, of the total of 1,307 included in Phase II. This subset of 315 respondents is referred to as "Phase 2.5" of the Diffusion of Innovations in Rural Societies Project. The reliability coefficients for these fifty-six items are shown in various publications of the Diffusion Project and in Stanfield (1968).

trust to an immanent approach which allows for a negative relationship, depending on the object of trust" (Stanfield, 1968, p. 148).

Stanfield suggests that trust within the twenty Brazilian communities "operates in a completely different manner from trust of outsiders." A person who trusts his neighbors "is usually a young, poor, little educated farmer who seldom ventures outside his community and has limited exposure to the mass media." Conversely, an individual who trusts outsiders, "such as the ACAR supervisor and the interviewer, has higher exposure to radio, newspapers, television and cinema, has higher education, a larger farm, and a higher level of living than a person who does not trust outsiders" (Stanfield, 1968, pp. 148-149).

According to Stanfield's (1968, p. 149) findings, "the crucial difference between those who trust their neighbors and those who do not, lies in the latter's greater communication with the outside world, or as we have phrased it, his greater cosmopoliteness."

In order to verify whether our data would yield results similar to Stanfield's (1968) findings, the variable <u>trust of agronomists</u> (ACAR supervisors, and therefore an outside source) <u>as compared to trust of neighbors</u> was correlated with communication integration. The result was a positive zero-order correlation coefficient

(r) of .13, but not significantly different from zero at the .05. The data do not support, therefore, Stanfield's (1968) findings. It should be pointed out, however, that Stanfield (1968) had the individual as the unit of analysis, and a sample of 1,307, while we have the community as the unit of analysis and a sample of 20.

Additional research on the relationship of interpersonal trust and communication integration is necessary, with other indicators of trust. It would be interesting to pursue further Stanfield's (1968) suggestions that a difference may exist between trust within and outside the community boundaries. This is an aspect which is directly related to our notion of system openness and its positive relationship with communication integration.

Opinion Leadership Concentration

Opinion leadership has been defined as the ability to influence other members of one's social system in a consistent and desired way. Opinion leadership in a given social system will tend to be highly concentrated if only a few individuals are influential. Under such conditions, interpersonal relations in the system as a whole are more likely to be hindered. On the basis of this argument, *Hypothesis 2* was proposed as follows: *The higher the degree of opinion leadership concentration in a given social system, the lower the degree of communication integration*.

The scores of communication integration and opinion leadership concentration for the twenty communities show a negative correlation ($r = -.31$). Although the result is in the direction predicted, Hypothesis 2 cannot be supported because the zero-order correlation coefficient is not significantly different from zero at the .05 level. Again, it should be emphasized that with a larger number of observations, the "r" obtained could have been significant.

Social Participation

Social participation is defined as the degree of an individual's involvement in the "social life" of his social system. Hypothesis 3 states that the higher the degree of social participation in a given social system, the higher the degree of communication integration

A social participation index was constructed for each of the twenty communities, and the scores of social participation were then correlated with communication integration. The results show low positive correlations between the two variables ($r = .03$). On the basis of the present data alone, it is not possible to support Hypothesis 3.

Mass Media Exposure

Mass media exposure has been defined in the present study as exposure to impersonal communication media, such as radio, television, newspapers, cinema, etc. Hypothesis 4 proposes that the higher the degree of mass media exposure in a given social system, the higher the degree of communication integration.

The scores of mass media exposure for the twenty communities included in the analysis show a positive correlation (r = .27) with communication integration, but this correlation is not significantly different from zero at the .05 level.

Since the mass media exposure index was based on four indicators--newspaper readership, radio listening, television viewing, and cinema attendance--the relationships of each of these items with communication integration was obtained. Table 8 shows the results of the zero-order correlation of the four items and of the mass media exposure index with communication integration.

TABLE 8. Correlation between Newspaper Readership, Radio Listening, Television Exposure, Cinema Attendance, the Mass Media Index, and Communication Integration in Twenty Communities of Minas Gerais, Brazil.

Mass Media	Correlation (r) with Communication Integration
1. Newspaper readership	.47*
2. Radio listening	.07
3. Television viewing	.11
4. Cinema attendance	.45*
5. Mass media exposure index	.27

*Significantly different from zero at the .05 level.

As can be observed in Table 8, positive correlations were found between each of the four items and communication integration. Newspaper readership and cinema attendance show higher correlations than radio listening and television viewing.

Although the results do not support the hypothesis that mass media exposure is positively associated with communication integration, they are in the predicted direction. Were the hypothesis to be reformulated, we could suggest that newspaper readership and cinema attendance are positively related to communication integration, while radio listening and television viewing show low positive correlations with communication integration.

The results obtained reinforce the argument presented in Chapter V that a social system which is relatively more open to exogenous influences, assuming that mass media represent one of these external inputs, is also likely to be relatively high in communication integration. Further research is needed, however, with larger samples, to study in more detail the proposed relationship.

It would be interesting also to be able to control on the role of certain social structural variables (like social class, which may determine television and radio ownership) in future analyses.

Cosmopoliteness

Cosmopoliteness refers to the degree to which individuals in a social system are oriented toward the external world, or the world outside their immediate social system. Hypothesis 5 was proposed to test the notion that cosmopoliteness, as a modernizing force, tends to increase interpersonal contacts within the system.

Hypothesis 5 was formulated as follows: The higher the degree of cosmopoliteness of a given social system, the higher its degree of communication integration. The index of cosmopoliteness, based on the number of visits to a large city (of 50,000 or more) in the previous year, shows low positive correlation (r = .03) with communication integration. On the basis of this result alone it is not possible, therefore, to confirm Hypothesis 5. This hypothesis was based on the notion that cosmopoliteness would tend to facilitate interpersonal relations within the system. It is possible, however, to turn the argument around and say that cosmopoliteness might act as an "impersonalizing" force within the system, which would eventually lead to a reduction of communication integration, rather than its increment. Yet the basic rationale that an open system is more amenable to higher degrees of communication integration would contradict the latter position.

To obtain further information on the possible relationship of communication integration and "extra-system" orientation (which can be equated to system openness, as proposed in Chapter V), a measure of the system's <u>external contacts</u> was determined, using the following indicators: Television channels available to the community, bus lines from the community to a relatively large city (50,000 or more inhabitants), number of visits made by respondents to the state capital city, existence of postal service, and telephone. The Guttman scores constructed for these various items correlate positively with communication integration (r = .38, significantly different from zero at the .05 level).

It is interesting to observe that cosmopoliteness, an individual-level measure, shows a relatively low correlation with communication integration (not significant at the .05 level), while external contacts, a system's level variable, shows relatively high, significant (at the .05 level) correlation with the same variable.

<u>Change Agents Contacts</u>

<u>Change agents contacts</u> refers to the frequency of interaction that respondents indicated they had with the ACAR supervisor in the year preceding the interviews. <u>Hypothesis 6</u> was proposed as follows: <u>The higher the degree of change agent contacts in a given social</u>

system, the higher its degree of communication integration.

The index of each community's contact with change agents was correlated with communication integration, and the results were a negative correlation of -.30, although not significant at the .05 level.

Since data were available to determine the amount of contacts that ACAR supervisors had had with each community (also in the year preceding the data gathering), this item was correlated with the scores of communication integration, and the results show a positive correlation ($r = .36$, significantly different from zero at .05) between the two variables.

Contacts with change agents is a measure obtained from the respondents interviewed in each community, while ACAR contacts with the community is a measure obtained from the ACAR supervisor. On the basis of the first set of data alone, Hypothesis 6 cannot be supported. However, on the basis of the latter results, it is supported.

Innovativeness

As already indicated, our main interest in communication integration stems from its potential usefulness as a predictor of innovativeness, and hence, modernization. Innovativeness has been defined as the degree to which an individual adopts new ideas relatively earlier than others in his social system. Hypothesis 7 was formulated as follows: The higher the degree of communication integration in a given social system, the higher its degree of innovativeness.

The innovativeness scores obtained for each of the twenty communities were correlated with the scores for communication integration, and the results show, indeed, positive correlations ($r = .36$, significantly different from zero at the .05 level) between the two sets of scores. Hypothesis 7 is, therefore, supported by the data.

This finding is in general agreement with results obtained by students of communication networks, regarding position in the network structure and effectiveness. As pointed out, one of the substantive findings of the network studies is that centralized structures tend to be more effective in the performance of certain tasks, as compared with decentralized structures.

Small group research has also shown that cohesiveness (which is a measure analogous to our measure of communication integration) and innovative behavior are correlated. Similarly, diffusion research has shown that early adopters generally occupy central positions in the informal communication structure of their social system.

This finding tends to support also results of studies conducted both in the United States (e.g., Coleman, Katz, and Menzel; and Becker, 1970) and in developing societies (e.g., Yadav, 1967; Rao, 1966; Leighton and others, 1963) which indicate that informal communication integration tends to correlate positively with modernization.

Summary

This chapter discusses the validity of the index of communication integration used in the present study, and presents results of the correlation of this index with seven variables for data obtained in twenty communities of Minas Gerais, Brazil. The hypothesized relationships between each of these seven variables and communication integration, and the results yielded by the data are summarized in Table 9.

In order to examine in more detail some of the results yielded by the data, additional analyses were made. The three items that were used to construct the interpersonal trust index were correlated, individually, with communication integration. Also, trust of an outside source, the ACAR supervisor, was correlated with communication integration. The four items that formed the mass media index were also correlated with communication integration, as well as external contacts, and change agents contacts with the community. The results obtained with these additional analyses, as well as those reported for each hypothesis, are summarized in Table 10.

TABLE 9. Anticipated Relationship of Selected Variables with Communication Integration and Results Obtained with Data from Twenty Communities in Minas Gerais, Brazil.

Variables	Anticipated Relationship with Communication Integration	Correlation Coefficient (r)
1. Interpersonal Trust	Positive	-.01*
2. Opinion Leadership Concentration	Negative	-.31**
3. Social Participation	Positive	.03**
4. Mass Media Exposure	Positive	.27**
5. Cosmopoliteness	Positive	.03**
6. Contacts with Change Agents	Positive	-.30*
7. Innovativeness	Positive	.36***

*Not significantly different from zero at .05 level; results in opposite direction of prediction; hypothesis rejected.

**Not significantly different from zero at .05 level; results in direction predicted; hypothesis rejected.

***Significantly different from zero at .05 level; results in direction predicted; hypothesis accepted.

TABLE 10. Zero-order Correlations of Intra-system and Extra-system Variables, and of Innovativeness, with Communication Integration in Twenty Communities of Minas Gerais, Brazil.

Variables	Correlation (r) with Communication Integration
I. Intra-system	
1. Interpersonal trust	
(1) Trust in neighbors	-.01
(2) Trust in majority of people	.09
(3) Belief in basic honesty of people	-.05
(4) Total trust	-.02
2. Trust of agronomist (ACAR agent)	.13
3. Social participation	.03
4. Opinion leadership concentration	-.31
II. Extra-system	
5. Mass media exposure	
(1) Newspaper readership	.47*
(2) Radio listening	.07
(3) Television viewing	.11
(4) Cinema attendance	.45*
(5) Mass media exposure index	.27
6. Cosmopoliteness	.03
7. External contacts	.38*
8. Respondents' contacts with change agents	-.30
9. Change agent contact with community	.36*
III. Innovativeness	.36*

*Significantly different from zero at the .05 level.

All variables were grouped into two categories--<u>extra-system</u> variables, and <u>intra-system</u> variables. The former are those variables that are considered to be more directly related to the social system's intrinsic characteristics, or inputs. The latter are more directly related to the system's exogenous inputs. Clearly, this is an arbitrary classification and does not necessarily imply that a variable such as opinion leadership could not be in either of the two sets of variables, or in both.

Innovativeness is shown as a separate variable, on the assumption that it is related to both intra-system and extra-system variables.

cosmopoliteness, respondents contacts with change agents, and opinion leadership concentration.

It was hypothesized that communication integration would correlate positively with each of these variables, except with opinion leadership concentration, with which it would correlate negatively. The reasoning for the latter prediction is that opinion leadership concentration usually means that only a few individuals in the social system are influential. Under such conditions, it is unlikely that informal interpersonal channels will be integrated. Social systems characterized by relatively low level of opinion leadership concentration, on the other hand, may offer greater opportunities for interpersonal contacts, and thus, greater communication integration.

The other variables analyzed are selected intra-system and extra-system variables that have been shown to correlate positively with innovativeness. Communication integration was regarded as a linking element between these variables and innovativeness, or modernization.

The results obtained show that opinion leadership concentration and communication integration are, indeed, negatively correlated. Although the finding is in the predicted direction, the hypothesis was not supported because the zero-order correlation coefficient (r)

Contrary to expectations, both interpersonal trust and cosmopoliteness showed negative correlations with communication integration. Although neither of the two correlations (r) is significantly different from zero at the level established (.05), contacts with change agents shows a relatively "higher" negative correlation (r) with communication integration than interpersonal trust. Nevertheless, both of these hypotheses were rejected.

In summary, of the seven hypotheses proposed, one was confirmed--this is the hypothesis that communication integration correlates positively with innovativeness; four were in the predicted direction, but not confirmed at the established level of significant (.05)--these were the hypotheses that opinion leadership concentration correlates negatively with communication integration, and that social participation, mass media exposure, and cosmopoliteness correlate positively with communication integration; and finally, two of the hypotheses were rejected because the results obtained were in the opposite direction of what was predicted--these were the hypotheses that interpersonal trust and contacts with change agents correlate positively with communication integration.

In order to explore some of these results further, each of the individual items that formed the interpersonal trust index was correlated with communication integration.

Of the three items, only trust in the majority of people correlates positively with communication integration, but the correlation was not significantly different from zero at the .05 level. The other two items correlate negatively with communication integration, but neither of the two correlations was significantly different from zero at the .05 level.

One speculative explanation for these results is that interpersonal relations might not necessarily depend on mutual trust, since the former may be structured on the basis of some goal-directed actions rather than on mutual feelings of trustworthiness among the community members.

Another possible explanation for the results obtained is that the items utilized did not adequately measure interpersonal trust. Test-retest reliability of these items showed positive correlations that were significantly different from zero at .001 level. It should be pointed out, however, that this test-retest reliability, although useful to verify the extent to which respondents were consistent in answering the same questions, on two different occasions, was not a validity test for the items utilized to measure interpersonal trust.

Working with the same data, but at the individual level, Stanfield (1968) found that interpersonal trust correlates negatively with several indicants of modernization. On the basis of these results he suggests that the "absolutist expectation of more development, more trust," should be reinterpreted to allow for a negative relationship, depending on the object of trust. He proposes that trust within these same twenty Brazilian communities operates differently from trust of outsiders. According to Stanfield's (1968) interpretation, those who trust their neighbors are mostly localite, and those who trust outsiders are mostly cosmopolite. To examine Stanfield's (1968) suggestion, a correlation of trust of agronomists (ACAR supervisors) and communication integration was computed, and the results show positive correlation between the two variables, but not significantly different from zero at the .05 level.

To examine in more detail the result obtained for the correlation between contact with change agents and communication integration, another variable--change agents contacts with the community--was correlated with communication integration. The result was a positive correlation between these two variables, significantly different from zero at the .05 level. Although the two measures are not exactly equivalent--respondents contacts with change agents were measured in terms of number of times they indicated they had talked with change agents in the year preceding the interviews, and change agents contacts with the community was measured in terms of number of visits made to the community, also in the previous year--the finding indicates that a more integrated community is "more open" to outside inputs, although its members may not necessarily seek contacts with outsiders, or in our particular case, with the ACAR supervisor. Hypothesis 6 would have been supported if it had been stated in terms of outside change agents contacts with the community, and not the community's contacts with outside change atents. These results suggest that external inputs (or extra-system) variables seem to be relatively more important in integrated communities than intrinsic inputs (or intra-system variables).

This modified hypothesis is further supported by the results obtained for the relationship between external contacts and communication integration. External contacts (a Guttman score of several indicators of the community's contacts with the outside world) correlates positively with communication integration, and this correlation was significantly different from zero at the .05 level. Cosmopoliteness, an individual-based measurement correlates positively, but at a very low level, with communication integration, whereas external contacts, a system-level measurement, shows positive, significant correlation with communication integration.

or vice-versa. Figure 9 represents these relationships. The broken lines represent the "weak" relationships attributed to internal inputs and the other elements of the model. The continuous line represents the "strong" relationships attributed to external inputs, communication integration, and modernization.

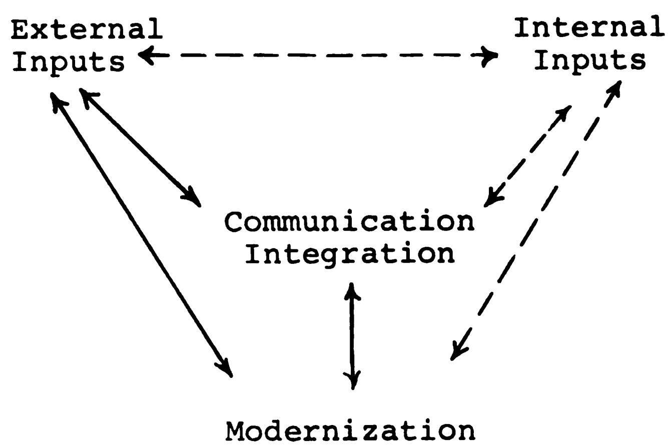

Figure 9. A Model of Communication Integration as Mediating Factor between External and Internal System Inputs and Modernization of a Given Social System.

One important question is whether "high" external inputs and "high" communication integration alone would be sufficient conditions for a system to "modernize." It seems that a system must be capable of reorganizing itself under the influence of external inputs, otherwise it would seem doubtful that external inputs would be of any relevancy to the system. This means, in other words, that certain intrinsic characteristics of the system, such as encoding mechanisms, boundary control, adaptability, openness, and so on, are directly related to the system's degree of communication integration, and hence, modernization.

What is proposed is that communication, as the information processing subsystem of the social system, would function as a mediating element in the process of change. When this mediating factor is "integrated," and the receiving system is open and capable of reorganization, it is more likely that the system will tend toward modernization.

Further Research

Two major types of future research should be considered: One type refers to some methodological aspects of communication integration, and the other, to certain substantive aspects. It would be necessary, for example, to make comparative analyses of some of the measuring techniques examined in the present study. Specifically, it would be interesting to compare the matrix technique used here with other models, especially in the study of different types of social systems, such as formal organizations, and with different types of data, so that other structural aspects of the communication network could be analyzed and compared.

Another methodological problem that deserves attention is the possibility of developing theoretical distributions for n-size matrices, with n-steps. These theoretical distributions could then be compared with actual data, and differences could be determined on the basis of, for example, the Chi-square statistic. One type of distribution that can be worked out, would be a distribution for the possible responses in any binary (0-1) matrix. All responses could then be placed into a two-by-two contingency table, such as the one shown in Figure 10.

	0	1
0	0,0	0,0
1	1,0	1,0

Figure 10. Possible Distribution of a Binary Matrix into a Contingency Table.

This approach would, however, be limited to 0-1 matrices, which are indicative of only direct, one-step connections in a communication network. But similar distributions could be worked for n-step links.

Further use of the computer routine utilized here would help in evaluating this methodology. Our data had a few limitations that hindered other potential uses of the network routine in the present study. First, the choices made by respondents were limited to three other persons in the social system; and secondly, the choices referred only to one type of communication--frequency of conversation with informal friends. These two conditions may have affected the shape of the communication structure in each community, as compared, for example, with a situation in which no limits of nominations were imposed on respondents, and other aspects of the individual's communication behavior were measured, like, for example, certain types of information seeking behavior.

Another limitation refers to the type of social systems studied. The data come from farm communities in Brazil, where the settling pattern is not always conducive to social interaction. This variable most probably also affected the shape of the communication structures analyzed. There were, for instance, relatively few dyadic (reciprocated) links, even in the most integrated communities, and only a few identifiable cliques.

Similarly, the number of liaison persons and bridge contacts was not significant enough to allow comparisons across the twenty communities.

The program employed here, and the analytical procedures that it implies, should be extended to other types of social systems, taking into account the factors indicated in the preceding paragraphs.

Another methodological aspect that needs attention refers to the use of other statistical models to analyze possible relationships between communication integration and other variables. The use of factor analysis, as well as multiple and partial correlations will be useful, if not essential, in future studies of this nature. An important element in future research, that is directly related to the type of statistical models utilized, is the size of the sample. A larger N is necessary in future research.

Some of the substantive suggestions for future research refer to a few of the variables included in the present study, particularly interpersonal trust, social participation, and cosmopoliteness. Other indicators, for each of these variables, should be developed and validated. With respect to interpersonal trust, Stanfield's (1968) suggestion that individuals differ regarding the object of trust--whether inside or outside the system--should be further studied.

Cosmopoliteness should perhaps be studied in relation to certain structural variables, such as education, income, status, and so on. The alternative argument that cosmopoliteness may act as an "impersonalizing" force within the social system, should also be considered in future studies.

Social participation and exposure to radio and television should be also analyzed in relation to certain structural variables, especially social class indicators. It is possible, for example, that exposure to these communication media are strongly dependent on ownership.

Additional studies should be made of the relationship between extra-system and intra-system variables, and of the role of communication integration in this relationship. Other intrinsic variables should be included in such studies, so that more definite conclusions about the role of intra-system variables in the model proposed in Figure 9 can be arrived at.

Individual-level analysis, combined with the aggregate level, may also contribute to further understanding of the role of communication integration in the process of change. One may find out, for example, that cosmopolite individuals interact mostly with other cosmopolite persons, a speculation that would explain, at least in part, the relatively low correlation of cosmopoliteness with communication integration. This type of analysis may help also in understanding further the relationships of interpersonal trust, and social participation, with communication integration.

Another possible study would be to identify communication networks among women, and compare such networks with those obtained for men. It would be interesting to determine possible similarities and differences between these two types of network structures, especially with respect to a variable such as communication integration. Another possibility is to study the communication structure of local social systems having the family as a unit of analysis. This type of research may have immediate practical implications for certain programs, such as family planning.

It would be interesting to compare also friendship networks, such as the one analyzed in the present study, with other types of networks, such as information-seeking networks, or power-based networks.

Another important aspect in future studies of this type is to be able to determine the physical or geographical dimension, or boundaries, of the systems studied. This may be an important variable to consider in studies of communication integration in local communities.

Future studies should also pay attention to the numerical dimension of size. The results obtained in the present study show that size is directly related to communication integration, and yet, small group research has shown the reverse to be the case.

Another possible research interest would be to relate communication integration with normative and functional integration, in order to explore further the suggestion made in Chapter I that communication integration is basic to an understanding of the other types of integration--normative and functional. It was suggested there that communication integration may even be designated as a major indicator of social integration in general.

In synthesis, the study of communication integration offers theoretical, methodological, and practical challenges. It is practically an unexplored research area.

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APPENDIX

PROGRAM NETWORK

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      PROGRAM NETWORK
C
C             S O C I O M E T R I C   I N T E G R A T I O N
C
      DIMENSION INDAT(400,25),LINE(400),NCHC(400),IW1(400)
      DIMENSION IW2(400),PREST(400)          ,INTEG(400)
      DIMENSION PRESC(400)          ,INTGC(400),NCSN(400)
      DIMENSION FMT(10),INPUT(25)
      DIMENSION ISUB(999),ID(999)
      DIMENSION LABEL(8)
      DIMENSION RROW(400),RCOL(400),RCENTR(400),RCENTC(400)
      TYPE INTEGER FMT
C                    TREAT BLANKS AS ZEROES ON INPUT
   -> CALL OLDIOH
      READ 99999,NPROB
99999 FORMAT(I5)
      DO 998 JAW=1,NPROB
  ?-> CALL RESET
      REWIND 8
      REWIND 9
      READ(60,1) NS,IKLQ,IPNCH,NFIELD,(LABEL(I),I=1,8)
    1 FORMAT(4I5,7A8,A4)
      READ(60,11)(FMT(I),I=1,10)
   11 FORMAT(10A8)
      KHIGH=0
      IAN1=0
      AN1=NS-1
      PRINT 997,(LABEL(I),I=1,8)
  997 FORMAT(*1* 20X,7A8,A4///)
C
      WRITE(61,71)NS
   71 FORMAT(*0     INPUT DATA FOR*,I4,* SUBJECTS*//)
      DO 105 I=1,NS
C     INITIALIZE CHOSEN SCORE ARRAYS
      RCOL(I)=0.0
      INTGC(I)=0
```

```
      NCSN(I)=0
      ISUB(I)=0
      ID(I)=0
      DO 105 J=1,NFIELD
  105 INDAT(I,J)=0
      DO 100 I=1,NS
      READ(60,FMT) ID(I),(INDAT(I,J),J=1,NFIELD)
      ISUB(ID(I))=I
      IF(ID(I).NE.0) GO TO 91
      DO 1030 J=1,NFIELD
 1030 INDAT(I,J)=0
      GO TO 100
   91 CONTINUE
      WRITE(61,90) ID(I),(INDAT(I,J),J=1,NFIELD)
   90 FORMAT(* *,I4,6X,25I4)
  100 CONTINUE
C                      ZERO OUT THOSE IDS NOT USED AS INPUT
      DO 20302 I=1,NS
      DO 20303 J=1,NFIELD
      DO 20301 K=1,NS
      IF(INDAT(I,J).EQ.ID(K)) GO TO 20303
20301 CONTINUE
      INDAT(I,J)=0
20303 CONTINUE
C                      PLACE ALL ACTIVE IDS INTO FIRST LOCATIONS OF ARRAY




      DO 20312 J=1,NFIELD
      M=J
20314 IF(INDAT(I,J).EQ.0) 20313,20312
20313 M=M+1
      IF(M.GT.NFIELD) GO TO 20302
      INDAT(I,J)=INDAT(I,M)
```

```
      INDAT(I,M)=0
      GO TO 20314
20312 CONTINUE
20302 CONTINUE
      DO 2001  I=1,NS
      NCHC(I)=NFIELD
      DO 2002  J=1,NFIELD
      IF (INDAT(I,J).LE.0) GO TO 2003
      INDAT(I,J)=ISUB(INDAT(I,J))
      II=INDAT(I,J)
      IF (II.LE.0) GO TO 2003
      NCSN(II)=NCSN(II)+1
      GO TO 2002
 2003 NCHC(I)=NCHC(I)-1
 2002 CONTINUE
 2001 CONTINUE
C
C     INPUT DATA ARE NOW IN, AND NO. OF CHOICES MADE BY EACH
C     GROUP MEMBER ARE COMPUTED.
C
C     NOW CHECK FOR ISOLATES, AND REDUCE N FOR EACH.
      DO 1010 I=1,NS
      IF((NCHC(I).LE.0).AND.(NCSN(I).LE.0)) 10101,1010
10101 IAN1=IAN1+1
      AN1=AN1-1
 1010 CONTINUE
      WRITE(61,1011) IAN1
 1011 FORMAT(*0*,I4,* ISOLATES HAVE BEEN REMOVED FROM CENTRALITY*/
     1* CALCULATIONS* //)
C     NOW CALCULATE INTEGRATION (SHORTEST NO. OF STEPS)
C
      WRITE(61,72)
   72 FORMAT(*1*,* OUTPUT MATRIX*//)
      DO 500 I=1,NS
      DO 140 J=1,NS
  140 LINE(J)=0
```

```
C     FILL WORKING ARRAY FROM CHOICES OF MEMBER I.
      NJ=NCHC(I)
      IF(NJ.EQ.0) GO TO 300
      DO 150 J=1,NJ
  150 IW1(J)=INDAT(I,J)
      LINE(I)=1
C
C     STEP THROUGH K ≠POWERS≠ OR STEPS, FILLING LINE ARRAY WITH
C     STEP NO. OF SHORTEST PATH FROM I TO EACH OTHER MEMBER.
C
      NIN=0
      N1=NS-1
      DO 200 K=1,N1
      IF(NJ.EQ.0) GO TO 300
      DO 205 J=1,NJ
      JJ=IW1(J)
      IF(LINE(JJ).NE.0) GO TO 205
      LINE(JJ)=K
      IF(K.GT.KHIGH) KHIGH=K


      NIN=NIN+1
      IF(NIN.GE.N1) GO TO 300
  205 CONTINUE
C     FILL SECOND WORKING ARRAY WITH NEXT LEVEL OF CHOICES, I.E.
C     CHOICES MADE BY THOSE NOW IN FIRST WORKING ARRAY
      NJ2=0
      DO 202 J=1,NJ
      JK=IW1(J)
      NCJ=NCHC(JK)
      IF(NCJ.EQ.0) GO TO 202
      DO 215 L=1,NCJ
      LL=INDAT(JK,L)
```

```
      IF(LINE(LL).NE.0) GO TO 215
      NJ2=NJ2+1
      IW2(NJ2)=LL
  215 CONTINUE
  202 CONTINUE
      IF(NJ2.EQ.0) GO TO 300
      DO 222 J=1,NJ2
  222 IW1(J)=IW2(J)
      NJ=NJ2
  200 CONTINUE
  300 CONTINUE
C
C     COMPUTE INTEGRATION, CENTRALITY, AND PRESTIGE STATISTICS
      LINE(I)=0
      INTG=0
      DO 350 J=1,NS
      IF(LINE(J).EQ.0) GO TO 350
      INTG=INTG+1
      INTGC(J)=INTGC(J)+1
  350 CONTINUE
      INTEG(I)=INTG
C     WRITE OUTPUT LINE FOR THIS MEMBER.
   41 FORMAT(*0*)
      CALL RANOUT(I,LINE,NS)
      WRITE(61,4) IJ(I),(LINE(J),J=1,NS)
    4 FORMAT(* * I3,2X,60I2,(/6X,60I2))
      WRITE(9)          (LINE(J),J=1,NS)
  500 CONTINUE
C                   CALCULATE INVERTED MATRIX
      ENDFILE 9
      REWIND 9
      WRITE (61,700)
  700 FORMAT(*1REVERSED DISTANCE MATRIX*)
      FNM1=NS-1
      KHIGH=KHIGH+1
      DO 750 I=1,NS
```

```
      READ (9) (LINE(J),J=1,NS)
      NRC=0
      DO 730 J=1,NS
      IF(LINE(J)) 730,730,725
  725 LINE(J)=KHIGH-LINE(J)
      NRC=LINE(J)+NRC
      RCOL(J) = RCOL(J) + LINE(J)
  730 CONTINUE
      WRITE(61,4) ID(I),(LINE(J),J=1,NS)
      RROW(I)=NRC
  750 CONTINUE
C                    CALCULATE INVERTED MATRIX ROW,COL SUMS + CENTR SCORE
      GRPCNT =0.0
C
C     COMPUTE CHOSEN SCORES
      DO 760 J=1,NS
      RCENTC(J)=RCOL(J)/FNM1
      RCENTR(J)=RROW(J)/FNM1
      IF(RCENTC(J).GT.0) GO TO 753
      PRESC(J)=0.0
      GO TO 754
  753 PRESC(J)=INTGC(J)/ (RCENTC(J)*FNM1)
      GRPCNT   = GRPCNT   +RCENTC(J)
  754 IF(RCENTR(J).GT.0) GO TO 756
      PREST(J)=0.0
      GO TO 760
  756 PREST(J)=INTEG(J)/ (RCENTR(J)*FNM1)
  760 CONTINUE
      WRITE(61,769)
  769 FORMAT(*1SCORES FOR INTEGRATED SUBJS. USING INVERTED MATRIX*/
     114X,*CHOOSING (ROW)*,32X,*CHOSEN (COL.)*/*   SUBJS. INTEG. SUM   R
```

```
     2EL. CENT. PREST.*,12X,*INTEG. SUM    REL. CENT.    PREST.  ISOLATES*
     3 //)
C      PRINT INTEGRATION, CENTRALITY AND PRESTIGE SCORES, FLAGGING
C      ISOLATES.
       DO 770 I=1,NS
       IF(INTEG(I)+INTGC(I)) 483,483,402
  402 CONTINUE
       WRITE(61,771) ID(I),INTEG(I),RROW(I),RCENTR(I),PREST(I),INTGC(I),
     1 RCOL(I),RCENTC(I),PRESC(I)
  771 FORMAT(1H ,I6,I7,F5.0,F11.4,F10.4,10X,I7,F5.0,F11.4,F10.4)
       IF(IFNCH.GT.0) PUNCH 9771,ID(I),INTEG(I),RROW(I),RCENTR(I),PREST(I
     1),  INTGC(I),RCOL(I),RCENTC(I),PRESC(I)
 9771 FORMAT(I4,I6,F5.0,F10.4,F10.4,I10,F5.0,2F10.4)
       GO TO 770
  483 WRITE(61,482) ID(I)
  482 FORMAT(86X,I4)
  770 CONTINUE
       GRPCNT=GRPCNT/NS
       WRITE(61,775) GRPCNT
  775 FORMAT(*-SYSTEM INTEGRATION INDEX IS* F12.4)
C
C
C      NOW CALL LIN≠S CLIQUE ANALYSIS, IF DESIRED.
C
C
       IF(IKLQ.EQ.0) GO TO 999
C-----------------------------------------------------------------------
C         CLIQUE DETECTION SECTION
C-----------------------------------------------------------------------
C
       WRITE(61,5)
    5 FORMAT(*1*,* CLIQUE DETECTION FOR THIS DATA SET.*//)
       DO 600 I=1,NS
       IMAX=0
C      FIND HIGHEST REMAINING INTEGRATION SCORE
       DO 605 J=1,NS
```

```
      IF(INTGC(J).LE.IMAX) GO TO 605
      IMAX=INTGC(J)
      K=J
  605 CONTINUE
      IF(IMAX.EQ.0) GO TO 999
    → CALL RANIN(K,LINE,NS)
      WRITE(61,62) I,ID(K),IMAX


   62 FORMAT(*0*,*CLIQUE NO. *I4 / *     CENTER PERSON IS *,I4,
     1* (INTEGRATION= *,I4,* )* / *    MEMBERS + STEPS* )
      DO 610 J=1,NS
      IF(LINE(J).LE.0) GO TO 610
      WRITE(61,63) ID(J),LINE(J)
   63 FORMAT(* *,10X,2I5)
      INTGC(J)=0
  610 CONTINUE
      INTGC(K)=0
  600 CONTINUE
C                END OF CLIQUE DETECTION
C
  999 WRITE(61,68)
   68 FORMAT(*1*)
  998 CONTINUE
    > RETURN
      END
      SUBROUTINE RANACS(NOREC,ISTRT,NO)
      DIMENSION ISTRT(400)
      DATA(LAST=0)
      ENTRY RANOUT
      IF (NOREC.NE.LAST+1) GO TO 100
      WRITE(3) (ISTRT(I),I=1,NO)
      LAST=LAST+1
```

```
      RETURN
      ENTRY RANIN
      I=NOREC-LAST-1
      LAST=NOREC
      IF (I) 1,2,3
    1 I=-I
      DO 11    J=1,I
   11 BACKSPACE 8
    2 READ( 8)(ISTRT(I),I=1,NO)
      RETURN
    3 DO 12    J=1,I
   12 READ ( 8)
      GO TO 2
  100 PRINT 10
   10 FORMAT(*TOO BAD, WE NEED A MORE COMPLEX SUBROUTINE*)
      STOP
      ENTRY RESET
      LAST=0
      RETURN
      END
```