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ABSTRACT

The author's main concern is to provide a research format which will supply a unitary conception of communication. The wide range of complex topics and variety of concepts embraced by communication theory and the rather disparate set of phenomena encompassed by communication research create this need for a unitary study approach capable of linking all levels of analysis. The author proposes a cybernetic model which will allow for the exact specification of the rules and structures of the elements in the whole system. In support of this approach, the author notes that interpersonal, small group, organizational, and mass communication can be viewed productively as systems utilizing the cybernetic model. He concludes that the overriding concerns of cybernetics--regulation and control--are the most interesting and fruitful areas for research in communication systems. (LG)

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RECASTING COMMUNICATION THEORY AND RESEARCH: A CYBERNETIC APPROACH

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Research and theory are part of the means by which man seeks to understand himself and the world which surrounds him. In varying degrees of sophistication they have been the guides to knowledge and indeed, survival itself. Different periods in history have had their own particular subjects in which theory and research have been invested. Science today is concerned with a wide range of complex topics not the least of which is communication. There is little doubt that communication theory currently embraces a wide variety of concepts and research encompasses a rather disparate set of phenomena. Investigations range from studies of the simple machine to third generation computers, from the interpersonal contact between two humans to the level of international integration. Thus, the term communication has come to imply a vast array of ideas in a myriad of fields.

This paper poses the question as to whether communication refers to something which is common to all these levels of analysis. There may be objections to this line of questioning, however. Some may contend that the parochialism of communication theory and research must persist until the pieces are well developed at which time integrative work may be started. Perhaps the troubled state, i.e., theoretical disarray, of communication theory exists because of the efforts of scientists to find a commonality, some thread of similarity running through these levels of analysis.

The view of this paper, however, is quite the opposite. What is suggested presently is that the structure of scientific inquiry, research, and indeed knowledge itself, demands the push for more unified science. The payoffs that have been experienced through the cross-fertilization of other disciplines, e.g., physics, economics, and biology, tend to support the arguments in favor of such an approach.

One can proceed in one of two ways. First there is the problem of answering the question of what the 'something' is that links together this vast array of phenomena in which we are interested. The second track which one may follow is to ask how the problem of communication is to be approached. In other words, how does one study the 'something'? Of the two strategies the second is more appealing since it supplies a framework for analysis. The first approach demands the tedious operation of examining various types and modes of communication, comparing them and synthesizing the results in order to discover the similarity which was being sought. Often this approach results in nothing more than a disparate collection of unrelated, but interesting, facts and notions. It is primarily beset with the problem of translating jargon from one discipline into another where it is often found to be quite anomalous.

The second approach deals with the problem of unrelated terms and meaning by proposing at the outset a research language. Thus the informing question has been changed quite drastically. It is no longer a problem of discovering "what is communication?", but rather, it is concerned with providing a research format and asks --"how should one approach the study of communication?" This strategy, if successful, should answer the original question and supply additional benefits in the form of a more unitary conception of communication.

These are statements which promise a great deal, but how does one proceed? To begin, one must recognize that it is a model which is being sought. One which provides a research language suitable for the multi-faceted analysis of communication. The search for models in science is ubiquitous. Karl Deutsch relates:

> We are using models, willingly or not, whenever we are trying to think systematically about anything at all. The results of our thinking in each case will depend upon what elements we put into our model, what rules and structure we imposed on those elements, and upon what actual use was made of the ensemble of possibilities which this particular model offered.[1]

The important point in Deutsch's statement concerns the rules and structures imposed on the elements of the model. One must be in a position to specify quite explicitly what those rules and structures are or else the model is of little use. The model utilized in this paper is a cybernetic one; it was chosen since it allows one to be quite exact about rules and structures of system elements, in fact, this is one of its overriding concerns.

It is not unreasonable to ask why cybernetics is being utilized as a proposed model for theory construction and research in the field of communication. The concept has been around for nearly a quarter century and many people are quite familiar with its applications and limitations. Familiarity, however, is not the point. It was previously stated that the purpose of this paper is to examine the possibility for a research language or format for studying communication, a topic which crosses many levels of systemic concerns. Thus, what one needs is a general systems approach and cybernetics is indeed just that. Furthermore, it is a research language but one which has been badly abused through what could be called the "piecemeal approach" of science. All too often a new concept surfaces in some field and its more interesting and intriguing components subsequently appear in the jargon of a wide range of other disciplines. After investigating the practical and theoretical possibilities which the new terms present, the jargon is either abandoned or adopted.

This process is commonplace in science and not to be condemned outright but one should exercise caution in such an approach in order not to misuse or otherwise abuse fledgling notions when only pieces of the concepts are incorporated. It is this writer's view that cybernetics was much misused and abused by the piecemeal approach and consequently was abandoned as not being a fruitful strategy in many fields. As example, someone should have said 'whoa!' when feedback came to refer indiscriminately to anything from the operation of a thermostatic mechanism to the therapeutic discussions between lovers seeking some type of accord after a disagreement. Cybernetics is a systems concept, a unitary scientific approach with certain basic foundations not amenable to partial translation and ad hoc causal usage.

This paper proceeds on the premise that if cybernetics is to be used in a communications approach, steps must be retraced to the beginning and the foundations layed out anew. This paper is essentially cybernetics revisited. As the basic ideas are discussed, it is hoped that the possibilities for cybernetics being a guidepost for communication research will be seen clearly.

To achieve this goal necessitates there being some source to act as both a guide and a repository for ideas. To this end the work of W. Ross Ashby has been chosen as the primary source for re-introducing cybernetics. His books, Design for a Brain and An Introduction to Cybernetics are the basic references and many of the following ideas are borrowed from them although the author is responsible for present applications and interpretations.

There are reasons, beyond mere assertion, for the adoption of a cybernetic strategy. Ashby discusses two "peculiar scientific virtues" of cybernetics. The first virtue relates to an earlier point, that of a common research language. Cybernetics is particularly useful since it provides for a single vocabulary and a single set of concepts which are applicable to the most diverse types of systems. As example Ashby cites the difficulties that were inherent in relating facts about a cerebullar reflex and a servo-mechanism. Each phenomenon was explained in its own particular terminology which obfuscated their similarities. Cybernetics provided the language and the format for relating these two branches of science. The point being that while neither phenomenon can provide sufficient proof for the existence of the other, "cybernetics is likely to reveal a great number of interesting and suggestive parallelisms between machine and brain and society."[2] Likewise, the machine, brain, and society may have similarities in communicative processes which are clouded by their own specific research language. Perhaps cybernetics will assist in discovering the similarities.

The second virtue of cybernetics concerns its handling of complex phenomena. Ashby asserts that cybernetics "offers a method for the scientific treatment of the system in which complexity is outstanding and too important to be ignored."[3] Historically, the study of systems has had two approaches. Either the systems were sufficiently simple or they were able to be broken down into simple components. Complex systems whose components were not capable of being isolated due to the pervasive interactive effects of their parts, were ignored or their investigations met with little definitive success. Today science is dealing with complexity as a subject itself and cybernetics is one of its methods. It is cybernetics which hopefully offers effective methods for studying and controlling systems that are intrinsically extremely complex.

These statements serve as a nice introduction to a definition of cybernetics and a discussion of its social science application. Norbert Wiener was the first to coin the term cybernetics and he defined it as the science of communication and control. The basic perspective of cybernetics and its relationship to the social sciences is seen by Wiener to be the following:

> The existence of Social Science is based on the ability to treat a social group as an organization and not as an agglomeration. Communication is the cement that makes organizations. Communication also enables a group to think together, to see together, and to act together. All sociology requires the understanding of communication.
>
> What is true for the unity of a group of people, is equally true for the individual integrity of each person. The various elements which make up each personality are in continual communication with each other and affect each other through control mechanisms which themselves have the nature of communication.
>
> Certain aspects of the theory of communication have been considered by the engineer. While human and social communication are extremely complicated in comparison to the existing patterns of machine

> communication, they are subject to the same grammar; and this grammar has received its highest technical development when applied to the simpler content of the machine.[4]

Wiener states that it is communication which holds these organizations (systems) together. Thus it is the ability to transmit information, receive it, and react to it that is of central importance in understanding how systems operate. Deutsch underscores this point:

> ... cybernetics suggests that steering or governing is one of the most interesting and significant processes in the world, and that a study of steering in self-steering machines, will increase our understanding of problems in all these fields.[5]

Thus, communication and how it is utilized by the system to steer or govern itself and its interactions with other systems is the most overriding concern of cybernetics.

The same reasoning is equally applicable to interpersonal, small group, organizational, or mass communication topics. These units of analysis are indeed systems and as such, are subject to control and regulation in a wide variety of forms. It is suggested presently that the forms of regulation and control are the most interesting and fruitful areas for communication research and theory. Once understood, knowledge of the control and regulatory functions would go a long way toward understanding the phenomena of communication.

The road to understanding is lined with new questions and new ways of conceptualizing problems. With cybernetics, one is not interested in "things", but rather, in "ways of behaving". The important question is not, "what is this thing?" but,"what does it do?" Thus, one develops essentially a process orientation, not an unfamiliar bearing for the social scientist. Beyond this, however, questions are asked that center around the notion as to why a particular case conforms to its usual, particular restriction. The important analysis concerns the extent to which any system is subject to "determining" and "controlling" factors which provide for the particular case.

Communication research is particularly suitable to the cybernetic approach since communication is essentially "a way of behaving". More importantly, however, communication viewed as a system of interaction can be said to engender the processes of regulation and control. One could investigate many interesting topics in a communication system, whether the system be a large organization or a small group. As example, the lines of attraction and avoidance are always of interest since knowledge of them facilitates the prediction as to the origination of messages, to whom messages will flow, and much about how they will be received. Other research emphasizes the importance of identifying the critical variables affecting the predisposition to communicate and the consequent effects on behavior.[6]

These are researchable topics, but the question remains as to whether answers are obtainable if guided by current research conventions and theoretical orientations. The communicative act is the product of inherent complexity and, as stated previously, cybernetics has the "peculiar virtue" of offering a method for the scientific treatment of systems whose complexity is outstanding. Ashby notes that

> ... the fact that such dogma as 'vary the factors one at a time' could be accepted for a century shows that scientists were largely concerned in investigating such systems as allowed this method; for this method is often fundamentally impossible in the complex systems ... there are complex systems that just do not allow the varying of only one factor at a time-they are so dynamic and interconnected that the alteration of one factor immediately acts as a cause to evoke alterations in others, perhaps in a great many others.[7]

Thus one is left in a rather uncomfortable position being told that the 'old methodology' is largely inadequate and that research needs to be re-cast into a new framework -- cybernetics. The important question now is what form this new framework assume?

To answer this, one must consider the research questions which cybernetics would immediately ask. The questions focus upon a system's regulation, what is being regulated?, how is it regulated?, and finally, what are the regulators? From this beginning the search would proceed to identify such factors as the variety of information in the system, how that variety is expressed in system states, what system vectors exist, and what the trajectory is for the system. This is the skeleton of a cybernetic approach. Let us examine it more closely.

There are three fundamental notions in cybernetic thinking which must be understood before any application is to be attempted. The first is MECHANISM, the second is VARIETY, and the third is REGULATION. They are intricately related and knowledge of one is required before one can understand the next. Since they are of such fundamental importance, we will try to explain them as clearly and succinctly as possible and then demonstrate how they may be applied.

The term mechanism may cause some discomfort among the ranks of social scientists particularly when a determinate mechanism is the subject. Most social scientists have intuitively, if not scientifically, rejected the notion of determinate machines in their research as being inappropriate to the problems encountered in the study of social phenomena. Nevertheless, discussions about determinate machines are useful for introducing cybernetic concepts.

A mechanism may be thought of as a system and it may be either material or non-material. The system contains elements which in the cybernetic lexicon are called operands and they are acted upon by operators resulting in system change or transformation. Ashby uses the example of sun-tanning to illustrate the terminology. Under sun exposure, pale skin turns to dark skin. That which is acted upon, the light skin, is called the OPERAND, that which acts, the sun shining, is the OPERATOR, what the operand is changed to is the TRANSFORM, and the change that occurs is the TRANSITION and it specifies two states and indicates which changed to which. The single transition is overly simple, however, since change almost always affects more than one operand and their particular transitions. Thus, a set of transitions, on a set of operands, is a TRANSFORMATION. The transformation, it should be emphasized, is concerned only with _what_ happens, not with _why_ it happens. The implication is that one does not need to know what the operator is, but rather, only how it acts on the operands.

The operands and their quantity or value at any one point in time represent the system state. Taken over time, in a series, the sequence of states forms a line of behavior, or trajectory for the system. Trajectories are extremely valuable pieces of information in that they aid in the prediction of future states of the system and reveal such system properties as stability, equilibrium, or cyclical behavior.

It is important to note that a machine's state may be regarded and/or recognized as a whole without necessitating the specification of its components. In other words, one may recognize patterns of the whole (e.g., clouds) and as Ashby states: "a theory of unanalyzed states can be rigorous."[8]

Another perspective to system states is represented in the term VECTOR. A system vector is a complex variable set which defines the state of the whole system at some moment in time. A familiar vector example is the weather consisting of the components barometric pressure, temperature, humidity, etc.

Given the knowledge of system states and vectors, the process of change becomes more interesting and identifiable. In cybernetics, change has two meanings. The first meaning refers to the change from state to state, that is, "the machine's behavior changes under its own internal drive."[9] The second meaning refers to the change from transformation to transformation. This is change induced by an outside factor such as environment or an experimenter. The distinction is a crucial one, one of particular interest to the social scientist whose concern centers around systems and wish to know if the system change under study is a state change or the more pervasive and profound transformation.

The discussion of mechanisms, or systems, is concerned with providing the language and tools to describe the main properties of the machine and its "way of behaving". The new question that is posed with the subject of variety extends the consideration of system into the fundamental questions as to "what the machine might do". The new orientation thus requires consideration of a set of possibilities. This leads to the subjects of information and communication, "and how they are coded in passages through the mechanism."[10]

Variety refers to the number of distinguishable elements of information about the system. It is variety which is essential to an understanding of how the system is constrained and thus, how it operates.

Mechanism is the subject which studies the processes within the system, variety is concerned with studying the processes of communication between system and system, and regulation is essentially related to the flow of variety in the system. The cybernetic law of prime importance is that "the quantity of regulation that can be achieved is bounded by the quantity of information that can be transmitted in a certain channel."[11] Furthermore, possibilities exist for measuring the amount, or degree, of regulation in the system. Unfortunately, examples of how this can be done is not within the purview of this paper.

The framework is complete, mechanism describes the elements of the system, variety relates how those elements operate, and from this the system exhibits its regulation. These are the basic ideas that Ashby presents. It is an interesting discussion he provides, but exactly how does this apply to the present interest in communication theory and research? We can illustrate the application by recasting some previous research into a cybernetic framework.

Small group research investigating patterns of transmission under differing social conditions provides an interesting example. Research in this area has been interested in such things as the effect of the structure of social connections, of the 'culture' of the group, and the contextual aspects of a situation within a group as it relates to interpersonal communication networks. To examine the problem, one of the first cybernetic tasks is to identify the operands in the system of the small group, or in other words, what are the elements that are being acted upon? This question underscores the main difficulty in a 'traditional' approach to communication research. It is extremely difficult to separate independent and dependent variables. One study suggested that the rate of contact and topic of communication be identified as the dependent variables,[12] these would be the operands in the cybernetic lexicon. The independent variables were declared to be the elements of group structure (e.g., size, propinquity, cohesiveness, status rankings, etc.), the "culture" of the group, and the contextual aspects of the situation. In cybernetic terms, these are the operators. It is convention to identify dependent and independent variables and to proceed on the basis of predicting the one from the other. In a cybernetic approach, this is not necessary. Cybernetics is not interested in such a question, rather it asks "what happens in the group?" To find out, one would identify the system's operands and the system vectors.

The operands are, as we have already stated, such elements as the rate of contact and the topic of communication, but it is erroneous to assume that such factors as group cohesiveness, degree of interdependence, group culture, or the context of the situation, are operators. There is nothing to suggest that these factors are not subject to state changes or transformations to the same extent as are the other operands. In other words, there is no identifiable operator proposed in this case apart from mere speculation as to group size, similarity of attitudes and interests. The interactive effects of these variables are so great as to defy independent and dependent labels and the consequent varying of factors one at a time. In the cybernetic approach it should be recalled, that it is not necessary for the operator to be known; all that is required is knowledge of the operands and their transitions. This information supplies the knowledge of the dynamics of the system through vector descriptions.

Again, in review, the vector is a list of operands and the system state they represent at any moment in time. The vector is a "reading" of the dynamics of a system since it allows one to know the form or position which the system assumes. It is the identification of vectors which appears to be the critical problem for research. Research efforts should be refocused toward the identification of systems of communication and the thorough description of their vectors. Such understanding must be achieved if the dynamics of the communicative act are to be known in their relationship to process and change in social phenomena.

From the knowledge of system operands, their transformations and vectors, one may proceed to study how communication is transmitted and coded as information as it passes through the system and interacts with other systems. This is the key to understanding the variety manifested by the system and hence how that system is constrained, regulated and controlled.

The recasting of theory and research into a cybernetic framework is no small task but it deserves serious consideration and attempts at case studies. This paper has attempted to provide an argument to support the cybernetic approach. Unfortunately it is short on details and specific illustrations but, hopefully, provides a necessary first step -- that of arguing for re-orienting the philosophy behind research and theory which now exists in the field of communication. As Ashby notes, cybernetics "offers the hope of providing the essential methods by which to attack ills - psychological, social, economic - which at present are defeating us by their intrinsic complexity."[13] The study of communication is no less complex nor less urgent in its need for understanding.

FOOTNOTES

1. Karl Deutsch, "On Communication Models in the Social Sciences", *Public Opinion Quarterly*, 1952, 16, pp. 358-7.
2. W. Ross Ashby, *An Introduction to Cybernetics*, London: Chapman & Hall Ltd., 1971, p.4.
3. *Ibid*., pp. 4-5.
4. As cited by Karl Deutsch in *Nerves of Government: Models of Political Communication and Control*, New York: Free Press of Glencoe, 1963, p. 77.
5. *Ibid*., p. 78.
6. C. David Mortensen and Kenneth K. Sereno, "The Influence of Ego-involvement and Discrepancy on Perceptions of Communication", *Speech Monographs*, 1970, 37, No. 2.
7. Ashby, *loc. cit*., p. 5.
8. *Ibid*., p. 30.
9. *Ibid*., p. 43.
10. *Ibid*., p. 121.
11. *Ibid*., p. 195.
12. Elihu Katz and Paul Lazarsfeld, "Interpersonal Networks: Communicating Within the Group", in *Personal Influence* New York: The Free Press, 1955, pp. 84-95.
13. Ashby, *loc. cit*., p. 6.