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ABSTRACT

The process of explanation as defined by the covering law model of science contains stringent criteria which often cannot be met by communication scientists. An alternative model, less powerful but more obtainable--the system paradigm--should be adopted. Four types of explanation provide a context for a discussion of the system paradigm alternative: scientific explanations, "what-explanations," mental concept explanations, and reason-giving explanations. Major advantages to using the system paradigm include a shift in the particular set of variables which are selected for study, an increase in the complexity of analysis which may be employed, and the ability to integrate current research findings into a wider perspective. (EE)

THEORY CONSTRUCTION IN THE STUDY OF COMMUNICATION:

THE SYSTEM PARADIGM

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The primary purpose of a scientific theory is scientific explanation. A theory is a set of propositions that are so related that taken together they logically explain the occurrence of some particular event. But scientific explanation--as contrasted with other forms of explanation--is an extremely difficult task. It is a carefully defined, narrowly delimited process which contains necessary conditions that must be rigorously met if the outcome of the explanatory process is to be considered valid. In this paper I shall argue that the process of explanation as defined by the covering law model of science contains stringent criteria which often cannot be met by communication scientists and that an alternative model for explanation, less powerful but more obtainable--the systems paradigm--ought to be adopted.

A theory also serves to predict. But explanation takes precedence over prediction, because a theory which explains must also predict while a theory which predicts need not explain. For example, scientists possessed a theory which allowed prediction of the tides long before they had one that explained them. The same is true of the motion of the planets.

Explanation can take many forms. Taylor [7] suggests four types--Scientific explanations, What-explanations, Mental concept explanations, and Reason-giving explanations--and we shall briefly examine these forms to provide a context for our discussion of the systems paradigm alternative.

"Scientific explanation," as defined by the covering law model, consists of a universal generalization that is assumed to be true, a particular set of circumstances, and a conclusion which asserts that an event had to occur because it was deducible from the logic of the propositions of the theory. The generalization upon which the explanation is built is considered satisfactory when it warrants the assertion of counterfactual propositions, i.e., propositions about what would have happened had circumstances been different. Thus, to establish a theory of communication is to seek a set of propositions that explain how communication operates, i.e., why various communication events are related.

Scientific explanations tell why a thing occurs, but the why is based upon the logic of the set of propositions. The power of the covering law model of explanation stems from the universal generalizations upon which it is built. As we shall see, this is also its most stringent demand which makes the model extremely difficult to use for the study of communication in many circumstances at this time.

"What-explanations" are attempts to specify what a phenomenon is. It is an explanation in that it removes uncertainty about the object by classifying and categorizing it with other phenomena, but it does not explain <u>why</u> the phenomenon is classified the way it is. For example, if we were observing small group interaction and you were to ask for an explanation of what was occuring at the moment, I might use the Bales IPA system and say, "Mr. Sedgwick is asking for orientation and Miss Peabody is showing solidarity." The explanation states how the behavior

is to be classified, but not why. It is in this sense that hypothesis testing is a what-explanation, not a why-explanation unless the hypothesis has been derived (deduced) from a theory based on the covering law model. The theory provides the why explanation. What-explanations can be scientifically useful for classifying phenomena, but they do little to advance our knowledge and understanding of communication.

"Mental concept explanations" are legion in the literature on communication. Examples of these concepts are motive, intention, belief, ability, knowledge, and dispositions. To use one of these concepts to explain a person's action is to describe that action as a part of a pattern of behavior. Identification of a particular action as a part of a pattern of action is explanatory because it classifies the behavior and informs us of what is occuring. Thus, mental-concept explanations are what-explanations. They do not attempt to relate two things in such a way that one could be predicted from the other. This form of explanation may be very useful, especially if the phenomena remain intractable to other forms of explanation. For example, in a recent article, Bennett [2]* suggests that there are three ways of predicting the output of communication systems: a physical explanation, a design explanation, and an intentional explanation, only one of which seems currently tractable when dealing with complex systems, the intentional explanation. He argues that in principle all three would serve

* See also Cappella [4].

to explain, but that in practice, treating a complex system as intentional proves to be the most manageable. When using mental concept explanations (such as intention) we should keep in mind the fact that they do not explain why in the same sense that scientific explanations do.

"Reason-giving explanations" account for why certain phenomena occur by showing why a person thought that a particular action or belief was right, correct, true, or a good thing to do. It offers answers to the question of why a person felt that a particular action was a good thing to do rather than why the action did in fact occur. The distinction is crucial for it is difficult to argue that mental states are the cause of physical events. Thus, reason-giving explanations allow us to assess a person's behavior in terms of his mental states and processes preceding his action, and nothing more.

These four explanations vary considerably in the extent to which they can provide strong, useful, valid accounts of phenomena. A strong explanation provides accurate and reliable control in principle over substantial parts of the environment; a weak explanation permits minimal often unreliable control over a limited part of the environment. Scientific explanation is considerably stronger than the other three modes; it is also the most difficult to achieve.

The validity of the covering law model is based on the assumption that a generalization can be established that will hold throughout space and time. There are three important problems in establishing the universal generalization. The first is the induction problem. Philosophers

have long pointed to the impossibility of examining all cases to arrive at a generalization; hence I will not discuss this point further. The second problems is more subtle. The notion of a universal generalization assumes that a phenomenon will be invariant through time and space. If, however, the behavior of a phenomenon changes depending upon the particular situation of the moment, then the assumption of invariance fails and the universal covering law model is inapplicable.

Many physicalphenomena have indeed been shown to be invariant through time and space, e.g., orbiting bodies, gases under pressure, light waves, etc. A number of scholars have argued, however, that such universality is not to be found among human behavior (c.f., Cappella [4], Toulmin [8]). Specifically, human communication is seen as culturally bound, rule-governed and characterized by choice rather than law-governed. Each of these points is taken up in the above mentioned papers, but it is important to note here that if communication is culturally bound, i.e., if symbolic behavior in one situation is not predictive of symbolic behavior in similar situations, then there is no possibility of establishing a generalization and the covering law model is inapplicable to the explanation of the phenomenon of communication.

There is a third important point to note about the covering law model: it is based on a single form of logic, specifically, set inclusive logic. There is nothing inherently wrong with this form of logic; it is simply one of several logics available today. The problem is that the covering law model utilizes only this one logical form casting

all phenomena and their explanations into the set inclusive mold. Thus, a logic is imposed on the phenomenon to be explained. Toulmin [8] argues that this procedure is inappropriate for explaining human action:

> We do not impose patterns or ideal forms on human behavior, as instruments within an intellectual analysis: rather, we recognize such general patterns as operative factors in human behavior. (p. 100)

I have argued that human communication is not characterized by universal patterns. If this is so, then it suggests that similar communication phenomena occuring in different cultural situations may operate by differing logics. Further, if we are to recognize patterns in rather than impose patterns on human action, then we need an explanatory form which (1) admits to a variety of logics and (2) permits changes in the choice of logic until one is found which is isomorphic with the phenomenon we seek to explain.

The difficulties in meeting the necessary conditions to employ the scientific model raises the question of what model of explanation we ought to adopt for constructing theories of communication. Some researchers have been so enamored with the covering law model that they have continued to use it despite the fact that they cannot meet its requirements and commit flagrant violations of its assumptions. Other researchers, in despair of ever meeting the stringent requirements, turn to weaker, less satisfactory modes of explanation--reason-giving explanations, for example--and seem content to operate on that level. I would argue that neither of these positions is useful. If the assumptions of the scientific model can be met, then it is the model to use. If the

requirements cannot be met, then while maintaining the ideal of the "natural science" scientific explanation, we ought to adopt the most powerful model of explanation whose assumptions we can meet. The systems paradigm is such a model.

Definitions of systems vary depending upon whether one is working within the domain of general systems theory, structural-functional analysis, or cybernetics. Common to all definitions, however, is the notion of a set of variables together with rules of transformation which define the relations among the variables. The system is defined as closed in that changes in any variable of the system are attributable to changes in the values of the other variables. Thus, a system is a formal logical structure which says nothing about the empirical world. It is this feature of systems, that they are based on a logical calculus, which can generate entailments for the system, i.e., warranted expectations.

A system is said to explain when: (1) the formal calculus entails expectations, (2) the terms of the calculus are loaded with empirical referents (by rules of correspondence), and (3) isomorphism is established between the logical system and empirical reality. Further, explanation is achieved by showing that:

> (1) If the terms of an abstract calculus are loaded with a given set of concepts, each linked by rules of correspondence to specific empirical perceptions, the rules of interaction of the variables in the system are matched by the relational propositions in the description.
> (2) Within the loaded system, the phenomena to be explained appears as a formal entailment.
> (3) Other entailments of the loaded system are matched by observations within the empirical situation [Meehan, 6, p. 57].

The justification for calling this process of determining isomorphism between a logical calculus and empirical referents an explanation is pragmatic--it works, and should the calculus not fit the real world, we make adjustments in the calculus until the two fit. Thus, the systems paradigm incorporates an essential feature of the scientific method, self-correction.

Having briefly reviewed the covering law and system paradigms, it is important to establish the criteria for distinguishing the two explanatory genres. There are five: (1) the use of generalizations; (2) the use of induction, (3) the relationship between logical and empirical processes, (4) the use of purpose, and (5) the extensiveness of the explanation. I will discuss them in the order listed.

(1) The deductive model is built upon the notion of the universal generalization; the system paradigm, on the other hand, requires only systemic non-universal generalizations. The appropriate statement in the deductive model is, "Throughout all space and time--here and elsewhere, past, present, and future--all X is Y." The non-universal system generalization is, "In this particular time and place--some specific time interval (say, the 1960's) and some specific place (say, the American culture)--all X is Y." The distinction between these two types of generalizations is crucial, for if we accept the argument outlined earlier that communication is culturally bound, then the covering law model with its universal generalization is clearly inadequate, while the systems explanation which uses situation specific generalizations is definitely appropriate.

(2) The universal generalization of the deductive model is established or certified by induction from empirical observation; without inductive certification deductive explanation is impossible. This fact causes researchers to "focus attention on the common features of classes of events and tends to lead to the examination of a representative sample of the members of a class [Meehan, 6, p. 49]." The system paradigm, however, is not constrained by the inductive process. Rather, it focuses on". . .the web of relations surrounding a single event, and examination of other members of the class does nothing to increase the power of the explanation. . .[Meehan, 6, p. 49]." Thus, in the systems paradigm any given event may be explained without examination of all other similar events; in other words, induction is superfluous.

(3) A universal generalization combines the empirical and logical processes because it "stipulates the logic of a relationship between two events [Meehan, 6, p. 49]." Thus, in effect, a universal generalization imposes a logic on events; it stipulates events to be related by the logic of the generalization. Further, it typically does so without justification or warrant for connecting the empirical description and a logical structure. The system paradigm, on the other hand, separates the logical and empirical processes. Any closed logical system may be employed which meets the needs of the situation. A logical system is sought which will match the logic the researcher recognizes in an empirical event. When isomorphism between the logic of the system and the logic of the event (its behavior) is obtained, explanation is taken as complete. Further,

the connection between the two processes is justified on pragmatic grounds, which we shall discuss more fully under #5.

(4) The deductive explanation is a formal paradigm which has been articulated without reference to the concept of purpose. The criteria for adequacy is the ability to generate inductive generalizations irrespective of the use to which the generalization is put. In this sense, adequacy is an all or none phenomenon: either the generalization holds and the explanation is adequate, or it does not hold and the explanation fails. In the systems paradigm, however, since alternative logics may be employed, alternative explanations may be given for the same phenomenon. Given alternative explanations, a choice among them must be made. The choice can most easily be made on the basis of the purpose for which the explanation was sought.

(5) Deductive explanations offer only single, complete explanations for an entire class of events, e.g., for all precipitation, all traffic deaths, all small group interaction. Explanations of part of the class are not permitted. The system paradigm, on the other hand, does permit partial explanations (which, of course, does not rule out the possibility of a complete systems explanation). Thus, a part of the number of traffic deaths per year may be attributed to drunken driving, bad weather, and poor roads. These factors do not explain all of the traffic deaths, but do explain some of them. The partial explanation is less powerful than the complete one, but it still is highly useful, especially in a young and growing science such as communication.

There are a number of advantages to using the systems paradigm, which go beyond its method of explanation. These include a shift in the particular set of variables which are selected for study, an increase in the complexity of analysis which may be employed, and the ability to integrate current research findings into a wider perspective. Let us look briefly at each of these advantages.

Those familiar with general systems theory know that systems display a number of important properties which are crucial to their operation. Among these properties are (1) stability, the state to which equilibrium systems return after disturbances, (2) variety, or the complexity of a system, (3) constraint, or the relations that obtain among the components of a system, (4) control and regulation, particularly of large systems, (5) information coding and transmission among parts of a system, and (6) growth and death.

These properties suggest a number of useful questions that can be asked about communication viewed as a system. (1) What is an equilibrium state for a person, dyad, or group and what part does communication play in helping reach this state? (2) How does the complexity of the communication system affect performance? (3) What group and societal constraints typically operate to produce communication structure and how does communication structure affect functioning. (4) How does communication function to control and regulate the behavior in specified situations? (5) Are certain information coding and transmission techniques more efficient for some tasks than for others? (6) Do com-

munication systems have life cycles; do they evolve through different stages? These and other questions like them should and will be, I believe, the focus of theoretical inquiry in the future.

The second advantage of the system approach is that it permits an increase in the level of complexity of analysis. We might parallel Ashby's [1] law of requisite variety--that only variety can destroy variety--by saying that only complexity can explain complexity. Thus, to provide a full explanation a phenomenon requires a logic of explanation commensurate with its complexity. Conceptualizations of communication offered in the past have represented it as an extremely complex phenomenon. This suggests that we need an explanatory model sufficiently complex to account for the complexity of communication. The systems paradigm is such a model.

The third advantage, the integration of existing findings, can best be handled by an example. In this example I shall also attempt to illustrate the other two advantages and sketch how the systems paradigm may be used to generate useful theoretical frameworks; the example is only one of several alternatives available.

In a recent book Blalock [2] outlines one approach to theory construction which includes the following steps: First, appropriate variables are selected from a review of the literature in the field, or from the scientist's experience in the area. Second, the relation between each pair of variables is specified (including the direction of

causality) e.g., as a increases b decreases.* Third, a choice is made as to which of the variables is to be explained. i.e., which are endogenous (dependent) and which are exogenous (independent). Fourth, a regression equation is constructed for each endogenous variable as a function of all other variables in the system. Some of the other variables will not be directly related to a particular endogenous variable, and hence their co-efficients will equal zero and they will drop out of the equation. Finally, a solution is sought for this system of (linear) equations by analyzing each equation separately and combining the results to provide a theoretic interpretation. It should be noted that this approach is appropriate for both static and dynamic theoretical formulations, and for simple recursive models as well as more complex interactive models.

To illustrate, let us examine a set of propositions offered by Collins and Guetzkow [5] to see how they could be developed into a systemic theory. I have selected six of the statements and reworded some of them slightly. They are as follows: (The numbers are those used by Collins and Guetzkow). For any person in a group,

9.2 The greater his initiation of communication, the greater his reception of communication.

*Zetterberg [9] specifies the dimensions of a relation which must be specified in any proposition: a relation must be (1) reversible or irreversible, (2) deterministic or stochastic, (3) sequential or coextensive, (4) sufficient or contingent, (5) necessary or substitutable. Zetterberg also offers a 6th dimension, the interdependent relation which is a combination of the reversible, sequential, and contingent attributes.

9.3 The higher his power status, the greater his initiation of communication.

9.4-A The higher his power status, the greater his reception of communication.

9.5a The greater his proximity, the higher his initiation and reception of communication.

9.5c The higher his socio-economic status, the higher his initiation and reception of communication.

9.6 The higher his initiation and reception of communication, the higher his uniformity of opinion with other members in the group. (p. 187)

These six propositions specify relations among six variables: socio-economic status, power status, proximity, initiation of communication, reception of communication, and uniformity of opinion. Three of these are endogenous variables: initiation of communication, reception of communication, and uniformity. Hence we need to establish three equations which will define the changes that will occur in these three variables as a function of the other variables in the system. Stated in verbal form, the regression equations take the following form:

1. Initiation = socio-economic status + power status + proximity

2. Reception = socio-economic status + power status + proximity + initiation

3. Uniformity of opinion = initiation + reception

The solution of this system of simultaneous recursive equations will permit statements regarding the effect of all of the exogenous variables on each of the endogenous variables. Thus, the interrelations among all of the variables may be determined. Should we wish to trace the behavior of this system over time to determine its equilibrium states and re-

action to perturbations, then we simply build in time as a variable, and convert the static regression equations to dynamic difference or differential equations.

I do not mean to imply that the above process is an easy one, but it is not much more difficult than other modes of analysis current in the field (e.g., analysis of variance, factor analysis, etc.) and as we have shown, it is explanatory. Further it is a level of analysis and explanation whose complexity is commensurate with the complexity of the phenomenon of communication.

In this paper I have reviewed the four primary forms of explanation and argued that the scientific model of theory construction, which has long been the modus operandi for communication research, is based upon assumptions which often cannot be met by researchers in the field. Thus theory construction in the future should abandon the covering law model when its assumptions cannot be met in favor of the systems paradigm, which provides for a slightly less powerful form of explanation, but one whose assumptions can more realistically be met. I believe that the adoption of this theoretical strategy will cause us to focus on a new set of variables and employ a new set of analytic techniques which will significantly increase the ability of communication scientists to understand, predict, control, and explain the phenomenon of communication.

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