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Answering Questions Requesting Scientific Explanations for Communication

The term explanation *has 2 valid senses: as a discursive activity and as the content of that activity. In the first sense, an explanation is an illocutionary act that provides an answer to an "audience" question about why some phenomenon behaves in a particular way. In the second sense, an explanation is the content of that answer. Although natural language philosophers have proposed some conditions for the discursive act of explaining, their proposals must be combined with some insights provided by scientific realists to distinguish what is specific to scientific, as distinguished from everyday, explanation. There are 2 major types of scientific explanation, causal and functional. An ideal scientific understanding of any communicative phenomenon requires both causal and functional accounts because the 2 work together to provide the types of knowledge that practitioners need to empower themselves and reach their goals as communicators.*

There are many different types of questions that can be asked about communication, and each requires a different type of answer. A question such as, "What was she talking about?" calls for a description or an attempt to fit the content of her utterance into a category. A question such as, "What is she going to talk about?" asks for a prediction, an estimate of the content of a future utterance. A question such as, "Why did she say that?" or "Why will she say that?" demands a third type of answer, one that increases understanding by giving a reason for the content of her past or future utterance. We call this type of answer an "explanation."

When faced with questions about communication that demand explanations, people often have ready answers, usually based on their beliefs about the speaker (e.g., "because she was angry") or the context in which the statement was made (e.g., "because the boss was listening"). Communication scientists also attempt to answer questions demanding explanations about discourse. Proponents of conventional (Pearce &

Cronen, 1980; Shimanoff, 1980) and cognitive (Berger, 1997; Kellermann, 1995) approaches have provided contrasting, and sometimes competing, reasons for the content of our utterances. Rather than commenting on or attempting to adjudicate this dispute, my goal in this essay is to step back and ask the more basic question, "What counts as a scientific explanation for communication?" It is difficult to evaluate the merits of contrasting proposals without some ground rules indicating what any proposal ought to accomplish.

Before taking on the basic question, there are two preliminary issues to address. First, the issues under consideration are relevant to the practice of communication as a "science" in the traditional use of that term, as a method dedicated to developing a corpus of objective, general knowledge about the prerequisites and results of communication. As such, the discussion is based on advances made in the philosophy of science over the past 25 years. During this time, the large majority of philosophers of science have rejected both logical empiricist (Carnap, 1966; Hempel, 1966) and "perspectivist" (Feyerabend, 1962; Kuhn, 1970) approaches. Commentators with divergent viewpoints (Laudan, 1996; Suppe, 1977; 1989; van Fraassen, 1980) have described the fatal weaknesses in both of these approaches and a review of them would go beyond the purpose of this paper. I would, however, like to point out one problem common to both: a general skepticism about the possibility of knowledge. Following from Hume's arguments showing that inductive generalizations cannot be proved to be correct, logical empiricists claimed that only the content of direct sensation could count as knowledge. Because of the theory ladenness of perception, perspectivists would not even accept that.

Boyd (1983/1991) and Harre (1986) have pointed out that both logical empiricists and perspectivists made the same error, that is, assuming that because knowledge claims cannot be proven, it follows that they are unjustified. Most epistemologists (BonJour, 1985; Pollock, 1986) now believe otherwise: One can make knowledge claims if one has good reasons for those claims, provided that one accepts the possibility that those claims may turn out to be wrong. This is but one reason why most current philosophers of science accept some form of scientific realism.[1] Specifically, although they differ drastically on other issues, most accept one or another version of "referential realism," the claim that unobservable theoretical concepts often refer to real objects with real causal powers (Harre, 1986; Rescher, 1987; Suppe, 1989). Throughout this discussion, I will assume a referential realism, under the presumption that most communication scientists accept the basic premise (Greene, 1994; Pavitt, 1999).

Second, as with other concepts, such as "meaning" (Grice, 1957) and "argument" (O'Keefe, 1977), "explanation" can be interpreted both as a discursive activity ("she explains how conversation works") and as the content of that activity ("cognition explains how conversation works"; Humphreys, 1988; Lewis, 1986). This essay addresses both interpretations in turn. In the first major section of this essay, I describe an approach to scientific explanation as a discursive activity by combining some insights of natural language philosophy with others from scientific realism. In the second major section, I turn to scientific explanation as the content of discursive activity and, in so doing, address the criteria that define an explanation as "scientific." In the third major section, I discuss two forms of scientific explanation that are particularly suited to accounts for communication. In the fourth and final section, I respond to some criticisms of this approach.

Scientific Explanation as a Discursive Activity

Before describing what scientific explanation is, it would be useful to mention what it is not. Scientific explanation is not a formal, logical relationship between theoretical statements and specific events. This view of explanation-through-logic dates to Aristotle (Ruben, 1990) but, although always implicit in logical empiricist thought, did not become explicit until Hempel and Oppenheim's (1948) deductive-nomological (hereafter D-N) model. The D-N model consists of a theoretical statement (or causal law) linking given antecedent conditions to the occurrence of an event as the major premise, statements establishing the presence of these antecedent conditions as minor premises, and a statement of the event's occurrence as the logical conclusion of the deduction. Several pseudo-explanations that follow from this model have been used as arguments against its validity, such as the "flagpole problem" (Bromberger, 1966), in which the length of a flagpole's shadow and the angle of the sun to the horizon are used to "explain" the height of the flagpole, as well as the following (Salmon, Jeffrey, & Greeno, 1971):

> People who take birth control pills do not become pregnant.
> Joe Schmo took birth control pills.
> Therefore, Joe Schmo did not become pregnant.

The major premise is a true theoretical statement, the minor premise and conclusion are also (conceivably) true, and the deduction is valid, so this example meets the D-N model's specifications. The whole exercise is irrelevant, however. Clearly, there is something fundamentally wrong with the D-N model, and attempts to revise or replace it while maintaining an emphasis on logic as the basis for scientific explanation (reviewed in Achinstein, 1983) cannot solve its problems.

Explanation as an Illocutionary Act

For a better approach to scientific explanation, I adopt the position of natural language philosophers (Achinstein, 1983; Scriven, 1959, 1962) and consider what is involved in the everyday discursive act of explaining. Presume that there is an audience with a question about why some phenomenon behaves in a particular way and a speaker who can provide a reason for that behavior. According to Achinstein (1983), the speaker is performing the illocutionary act of explaining when:

1. The speaker utters a "sentence" (the term Achinstein employed for the product of the discursive act) with the intention that it answers the audience's question.

2. The speaker believes that the sentence expresses the correct answer to the question.

3. The speaker utters the sentence with the intention that the utterance directly answers the audience's question rather than, for example, providing clues that allow the audience to eventually figure out the answer on its own.

Grice's (1957) theory of meaning implies an additional condition that the audience recognizes the speaker's intentions for what they are. Achinstein argued against that condition and, if we take Achinstein's argument to be correct, it then follows that a speaker meeting these conditions has successfully explained, whether or not the audience recognizes the speaker's utterance to be an attempted explanation. The advantage of Achinstein's position is that it distinguishes the illocutionary act of explaining from the perlocutionary act of the audience's gaining an understanding (see also Matthews, 1990). The corresponding disadvantage is that it then precludes our considering the audience's evaluation of whether the speaker has provided an *adequate* explanation. This is a problem for Achinstein's approach, because later Achinstein identified the audience's evaluation as a major factor in judging an explanation's adequacy. Thus, I believe it to be safer to include as a final condition, written as simply as possible:

4. The audience recognizes the speaker's intentions as described in conditions 1 and 3.

How, then, do we evaluate an explanation's adequacy? For both Scriven (1959, 1962) and Achinstein (1983), an adequate explanation is correct (contains true statements), complete (contains all the statements needed to lead to understanding), and relevant (of the correct type and level of complexity). Although the correctness of an explanation can be judged independently of context, the other two criteria can be evaluated only in light of the needs of the particular audience for whom it is directed—in Achinstein's terminology, the audience's "set of instructions" for the speaker performing the explanatory speech act. The relevance of an explanation depends on what the audience needs to understand, whereas the completeness of an explanation depends on what the audience understood previously.

It is informative to compare these three criteria to Grice's (1975) well-known discussion of the prerequisites for cooperative interaction. In short, successful information exchange is predicated on the presumption by both speaker and audience that a series of maxims is operative, with each maxim falling under one of the four categories: quantity (utterances should be neither less nor more informative than necessary), quality (utterances should never include items the speaker knows to be false or for which adequate evidence is lacking), relation (simply, utterance content should be relevant to the audience's needs), and manner (utterances should be clear, unambiguous, succinct, and orderly). What distinguishes these "conversational" maxim categories from other possibilities that are "aesthetic, social, or moral in character" (Grice, 1975, p. 47, with "be polite" as a proposed example) is that they, unlike the others, are necessary for successful conversational coordination.

The Scriven-Achinstein criteria (correctness, completeness, and relevance) are identical with the first three categories, except the second half of quantity, and it has been argued (Ruben, 1990) that a proposed explanation with too much detail is defective for that very reason. It also has been claimed consistently with the maxims of manner that a good explanation should never be presented "in a disorganized jumble" (Lewis, 1986, p. 194). There seems to be no need for other maxims; one does not need to "be polite" to explain successfully. Thus, we expand our notion of an explanation to include the thought that an adequate explanation meets Grice's conversational maxims.

Scientific Explanation as a Reductive Illocutionary Act

I believe that this view of explanation as an illocutionary act is essentially correct. It does, however, fail to reflect what is specific to scientific explanation, as opposed to other types. Neither Scriven nor Achinstein believed that scientific explanation has any features particular to it. In fact, the scientific audience's set of instructions for an adequate explanation includes a specific set of features, and commentators from vastly differing perspectives (examples include Harre, 1984; Salmon, 1984; Trusted, 1987) have largely, although admittedly not completely, agreed on what these special features are. First, scientific explanation is, contrary to the D-N model, not primarily concerned with the occurrence of single events. Rather, scientific explanation is concerned with the occurrence of a pattern of events displaying some regularity. Single events are explained by showing their occurrence to be an instantiation of the general pattern. Second, the content of the explanatory illocutionary act shows the occurrence of the pattern of events to be the natural consequence of underlying microstructures and microprocesses. Although often unobservable, these microstructures and microprocesses are taken to be real entities whose presence can be discerned through their effects on observable phenomena (Bhaskar, 1978; Harre, 1986). Third, the result of a scientific explanation is that phenomena once considered to be separate can be viewed as part of the same framework (Friedman, 1974; Kitcher, 1988). For example, Newtonian theory and the underlying microprocess of gravity (itself in need of explanation) revealed the previously unknown relationship among falling apples, rolling tides, swinging pendulums, and revolving planets. The end product is a more parsimonious view of the world.

Scientific explanations are by their nature reductive. Reality can be construed as existing on a variety of levels that can be ordered from more to less basic. Any pattern of events is explained in terms of structures and processes at a level more basic than itself. This should not be taken to imply that all sciences should be reduced to the most basic level (subatomic particle physics), as logical empiricists were often accused of believing.[2] On the contrary, even if we were successful in explaining, for example, biological phenomena through chemical structures and processes, the concepts and theories of biology would still be of value both in their own right as descriptions of relevant phenomena and for use as the explanatory basis for patterns of events on less basic levels.

A complete explanation for any phenomenon may require a description on many levels; to paraphrase Bhaskar's (1978) example, a complete answer to the question, "Why did she say that?" would require psychological, social, linguistic, physiological, and perhaps even more basic descriptions. To determine which level is best for a particular circumstance, one must turn to the set of instructions supplied by the audience (Achinstein, 1983; van Fraassen, 1980). Any given audience will generally be interested in only a subset, perhaps only one, of all potentially relevant levels. Note, however, that all are on a more basic level than the act of communicating. Phenomena on any given level cannot explain themselves.

This view of scientific explanation as reduction provides the criterion distinguishing scientific from nonscientific explanations that Scriven and Achinstein failed to supply and, in so doing, completes their illocutionary approach by specifying the general focus of the scientific audience's set of instructions. It also solves the problems presented by logical approaches mentioned above. If one were to limit the types of theoretical statements allowed in the major premise of a logical explanation to those specifying underlying microstructures and microprocesses, as Bhaskar (1978) and Harre and Madden (1975) recommended, then the length of a flagpole's shadow could not be taken to explain the height of the flagpole and Joe Schmo's consumption of birth control pills could not be considered relevant to his failure to become pregnant. Given a passage stating that "only the discovery of a micro-theory affords real scientific understanding of any type of phenomena, because only it gives us insight into the inner mechanism of the phenomena," it is surprising that Hempel and Oppenheim (1948) did not make this limitation a formal part of their model.

In short, an ideal scientific explanation is an illocutionary act meeting the four conditions described above along with Grice's conversational maxims. Its content attempts to show the underlying commonalties among different phenomena by describing the microstructures and microprocesses that underlie them. The end result is a more unified view of the world. In contrast with some claims, scientific explanation does not necessarily make the confusing understandable in terms of the readily familiar. Microstructures and microprocesses, such as those in nuclear physics, are often less familiar than the phenomena they explain. However, one sense of the term "understanding" is "placing something in a preexisting structure." It is with this sense of understanding that scientific explanations perform their function.

This view of scientific explanation as a reductive speech act can be subjected to various criticisms, some more telling than others. It is founded on scientific realism and, thus, presumably unacceptable to those who maintain an antirealist philosophy of science (Laudan, 1996; van Fraassen, 1980). Those who believe there to be no universally employed sets of instructions in science also will likely reject it. As an historical counterexample, Achinstein (1983, pp. 145–147) referred to the inverse relationship between the amount of pressure of a gas and the gas's volume (Boyle's law) as sufficient to explain the empirical relationship between the pressure and volume of a given sample. In my view, Boyle's law is descriptive of the relationship between pressure and volume but fails to explain why the relationship holds. Interestingly, advocates of scientific-explanation-as-reduction have used this very example to make their point. One of the first modern realists, Sellars (1963), when describing explanation, stated that "it is because a gas is—in some sense of 'is'—a cloud of molecules which are behaving in certain theoretically defined ways, that it obeys the *empirical* (Sellars's emphasis) Boyle-Charles's law" (p. 121). Harre and Madden (1975, p. 37) continued the example: Given this view of gas as particles, if we transfer a gas to a container only half the size of the original, the particles will bombard the walls of the container twice as quickly as earlier. As gas pressure is a manifestation of this bombardment, it will double, as Boyle's law describes. Herein lies the beginning of a scientific explanation.

A more serious challenge to viewing scientific explanation as a reductive illocutionary act is the proposed existence of "emergent properties" of objects that do not seem to follow from the properties of the objects' microstructure (e.g., at room temperature, water is a liquid although composed of two gases). If there really are such emergent properties, then all scientific explanation cannot be reductive. Realists would argue that the emergent properties of a whole could be explained, given sufficient knowledge of the properties of, and interactions among, its parts. It is, then, the content of our present-day explanations, and not the criteria we use in judging what counts as an explanation, that is in need of improvement. In this case, however, the burden of proof is on the realist to substantiate this argument.

Scientific Explanation as the Content of Discursive Activity

Most simply, to explain some phenomenon's behavior is to answer an audience's question about that behavior by providing a reason for it (Achinstein, 1983). As there are different types of questions the audience might ask, there are different types of explanation. Although not all types of questions demand, and not all types of answers provide, a scientific explanation, there are at least two types that do. One type of question calling for a scientific explanation is "how did such-and-such come about?" Attempted answers to this type of question are "causal explanations." A second type of question calling for a scientific explanation is "what purpose is served by such-and-such?" Attempted answers to this type of question are "functional explanations."

Causal Explanation

For Achinstein (1983), a causal explanation is simply an explanation whose content cites a cause. Although true as far as it goes, this characterization does not clarify what a "cause" is. In traditional empiricist thought following from Hume, a causal relationship consists of a regular co-occurrence of two events, in which one must occur before and thus is predictive of the other. There is no concept of force or power, which Hume deemed unobservable and, thus, a scientifically unjustifiable concept. However, although force cannot be seen, it can be felt, as when we fight the wind when we walk or the ocean current when we swim. Thus, we have empirical evidence that forces exist, and we are justified in inferring that forces are at work when we see leaves blow in the wind and ships tossed around in stormy waters (Hirst, 1959).[3] Realists, and even some self-labeled "antirealists," such as Cartwright (1983), presume the existence of force, and scientific causal explanation is based on the inference that certain objects, by the very nature of their attributes, have the power to affect other objects in given ways (Bhaskar, 1978; Harre & Madden, 1975). Causal force is not always expressed in movement. For example, the strength and rigidity of my table give it the power to hold up my computer keyboard and monitor, unless it is robbed of that power (e.g., burned in a fire). The regular co-occurrence of events is neither necessary nor sufficient to ensure causality: not necessary because causal power can be latent (an unexploded stick of dynamite) or counteracted by other causal powers (a rock too heavy to push), not sufficient because the co-occurrence can be coincidental or caused by a third, true force (night follows day, but is not caused by it).

Harre (1984; Harre & Madden, 1975) and like-minded scholars (Bhaskar, 1978) have emphasized one aspect of causal explanation—an understanding of the attributes of objects that serve as "generative mechanisms" giving the objects causal efficacy. However, time and space separate some causes from their effects, and an explanation of these linkages requires more than an understanding of relevant generative mechanisms. Salmon (1984) provided the example of a signal transmitted by a broadcasting station leading to music playing from the speakers of a far-off radio. The transmitter is the generative mechanism underlying the musical broadcast, and its causal powers can be explained through a description of its attributes and their operations. The signal does not have such causal force; rather, it serves as a "conduit" transferring that force from transmitter to radio. However, given that the radio cannot play music without the impact of the signal, a sufficient explanation for the music requires a linkage of events from the transmission of the signal (if that event is taken to be the critical generative mechanism) through the signal's movement to the radio and its transformation into audible sound.

Salmon (1984) and like-minded philosophers (Dowe, 1992) have examined the properties of processes that allow them to serve as conduits for causal force. For Dowe (1992), a process is causal if it conserves a quantity, such as momentum, energy, electric charge, or information, from the generative mechanism that caused it to its subsequent effect. Thus, a radio signal can play a part in a causal process if it maintains its amplitude and frequency as it moves, allowing it to transfer information from transmitter to radio. Causal processes must be distinguished from pseudo-processes that do not transmit their own structure. Salmon contrasts a moving car, which maintains its shape over space and time, with the car's shadow, whose shape and very existence depend on the car and the presence of a light source. If the car's shape is changed through collision with a wall, the change then maintains itself afterward, whereas if the shadow "collides" with a wall as the car drives past it, the shadow instantly returns to its former shape after the collision.

A scientific causal explanation is an illocutionary act that gives a reason for the behavior of some phenomenon or set of phenomena as the effect of some causal process. The description of the genesis of the causal force powering the process is in terms of microstructures and microprocesses that give some relevant object the power to get the process underway. These microstructures and microprocesses are always at a more basic level than the cause-effect relationship itself. A sufficient causal explanation also includes a description of the attributes of necessary intermediaries, giving them the capability of conducting causal force. Finally, both Salmon (1984) and Humphreys (1988) note that a complete causal explanation would include a discussion of factors both contributing to and counteracting the causal process. Thus, an informal and incomplete explanation for Salmon's example might read something like

> the transmitter (due to attributes *x* making it a suitable generative mechanism) caused the propagation of the signal which (due to attributes *y* making it a suitable conduit of information) resulted in the speakers playing music despite the potentially damaging presence of atmospheric inference due to lightning (another generative mechanism due to attributes *z*).

Causal Explanation and Control

An understanding of the generative mechanisms and causal processes that bring about a regular pattern of events allows for the potential control of that pattern. To have "potential control" over a pattern of events is to know how to bring that pattern about. Although one has a measure of potential control if one has a causal law linking events, actually to have potential control requires one to understand the microstructures and microprocesses underlying the pattern. To paraphrase Taylor's (1970) example, if one can predict that a given alloy is not strong enough to withstand the continuing stress placed on it from traffic load, rapid temperature changes, electric discharges, and the like, one can, in a sense, control bridge strength by not using that alloy. However, one will be stymied if faced with stresses that no available alloys meet. If instead one has an understanding of the determinants of alloy strength on the molecular level, one has the knowledge needed to go beyond the present-day repertoire of building materials and design a new alloy capable of more. In general, by showing what conceivably can be done, a theory including a scientific causal explanation provides the potential for far-reaching and creative advances in technology and practice beyond any previously envisioned.

This potential cannot be realized unless one not only is aware of how to bring about a desired effect, but also has the means to do so. Meteorologists might someday understand how to affect weather to eliminate hurricanes and tornadoes but be incapable of concentrating a sufficient amount of energy where it would be needed. Thus, we must distinguish potential control, or sufficient knowledge, from actual control, which is sufficient knowledge plus the capability of turning this knowledge into action. It is through actual control that theories can have practical effects on the world. Actual control has a somewhat different meaning in the social and behavioral sciences than it has in the physical sciences, analogous to the action-motion distinction (Burke, 1966; Harre & Secord, 1972). The physical sciences, including the biological, are concerned with phenomena without volition, so that to have actual control is to be able to manipulate directly a phenomenon under examination so that it will behave as you want. However, the social and behavioral sciences are relevant to phenomena with volition, as the human can lay waste to the best-laid plans of any potential controller. Thus, in the human sciences, actual control is the ability to manipulate the relevant context directly so that people in that context are more likely to act as theory suggests. For a nonscientific, real-life analogy, consider that we cannot directly control another's emotions, but our implicit theories tell us, for instance, that if we want to get a dinner guest in an amorous mood, soft music, lowered lights, and wine will increase the odds.

Functional Explanation

A functional explanation is relevant when the audience is confused about the purpose served by some phenomenon or set of phenomena either in the operation of some process or in maintaining the well-being of some object. Functional explanations operate under what Hempel (1965) called a "hypothesis of self-regulation"; that is, the continued operation of the relevant process or object is predicated on its developing appropriate characteristics. As a simple illustration (based on Trusted, 1987), the reason that grasshoppers are green rather than some other color is that it is harder for predators to detect a green-colored insect when the insect is walking in the grass. In other words, the purpose of the skin color is to increase grasshoppers' odds of survival.

One problem in developing functional explanations is determining which of the candidate characteristics perform what can be construed as functions. Although a function played by something is a consequence of that something's being there (the survival function of the grasshopper's color follows from the fact that it is that color), it does not follow that every consequence of something's being there counts as a function (if it turns out that its color makes the grasshopper more interesting to children, that, if anything, would work against its survival). Further, not everything that is there necessarily serves any function at all. The human appendix is there, but no longer serves any function except to become inflamed, which is contrary to human well-being. To clarify what can stand as a functional explanation, Wright (1976) provided the following formula:

The function of X is Z if and only if
(a) Z is a consequence of X's being there, and
(b) X is there because it does Z.

The account of the grasshopper's color meets both parts of the formula, whereas the alternate account (it fascinates children) fails to meet (a) and the account for the human appendix (it becomes inflamed) fails to meet (b).

To count as scientific, a functional explanation must include as its basis some underlying principle, analogous to the microstructures and microprocesses that underlie causal explanation, governing the functional relationship under examination. For the grasshopper example, a discussion based on natural selection will suffice. A complete functional explanation can include factors that both contribute to and counteract system functioning, although counteracting factors do not qualify as functions. Thus, a functional account for grasshopper survival rate would include both the positive and negative consequences of skin color. It is important to realize that, as Trusted (1987) has shown, functional explanations can always be "reduced" to causal factors; in this example, their color "caused" green-colored insects to have better survival rates than the other-colored. Further, when alternative characteristics could all serve the same function, a functional explanation cannot account for why one exists rather than the other. Neither of these caveats, however, contradicts the fact that functional explanations are valid answers to a different type of question than those answered by causal explanations.

Scientific Explanation in Communication

There are, then, two types of scientific explanation, causal and functional. The first type consists of an illocutionary act that answers the question, "How did such-and-such come about?" The second type consists of an illocutionary act that answers the question, "What is the purpose served by such-and-such?" It is my contention that an ideal scientific understanding of any communicative phenomenon requires both causal and functional accounts.

My reasoning is based on the further contention that one of the hallmarks that distinguishes communication science from allied disciplines is its emphasis on relevance to practice (Bochner & Eisenberg, 1985; Craig, 1984; Leff & Porcario, 1985). The communication scholar is committed to teaching people how to communicate so as to empower themselves in both public and private settings. In these settings, practitioners have certain goals that they want to achieve through the use of communication. In other words, practitioners want "control" over relevant situations, in the sense that that term is applicable to the social and behavioral sciences described above. As a practical discipline, communication science entails providing general accounts for how desired outcomes can be accomplished. Communication theories are of practical value if they provide such accounts and, in so doing, provide potential control.

Commentaries describing the development of communication science stress this emphasis on practice. For example, Rogers's (1994) history of mass communication research implies that its genesis can, for all practical purposes, be found in the persuasion and content-analytic studies performed as part of the World War II military effort by such pioneers as Hovland and Lasswell. Further, and particularly in those branches of communication science relevant to interpersonal interaction, an emphasis on practice is roughly equivalent to a concern with the sources of effectiveness (Williams, 1985). Rawlins (1985) described how essays characterizing what it means to be "interpersonally effective" date back to the 1920s. For Putnam and Cheney (1985), scholarship on communication in organizations "grew out of a concern for developing management skills, improving the effectiveness of various media, and discovering why communication fails" (p. 154). Bormann (1975) discussed how the study of group discussion developed during the early decades of the century as a response to the perceived need of average citizens to learn how to participate in community and organizational decision-making.

The study of group discussion is a particularly interesting case, as it exhibits more explicitly than other areas in communication the implications of this emphasis on practice. From the beginning, speech educators adapted Dewey's (1910) notion of the "reflective thinker" as a model for ideal group discussion procedure (McBurney & Hance, 1939). In Dewey's model, the reflective decision-maker, faced with a problem, thinks systematically through a series of sequential steps—analyzing the problem, developing an image of the criteria satisfied by an ideal solution to the problem, proposing a set of potential solutions, evaluating the extent to which the proposals match the criteria of the ideal solution, and finally choosing the proposal that best matches the ideal criteria.

Implicit in this recommendation is the outline of a theory incorporating a causal explanation of the genesis and impact of communication that would, if substantiated, provide potential control. Most simply, a group member's knowledge of and motivation to use reflective thinking serves as a generative mechanism leading to a well-reasoned discussion, a conduit likely to result in a high-quality group decision. From the standpoint of the practitioner, this theory implies a recommendation about how to improve communication in order to make a good group decision more likely. In this way, causal explanations can provide part of the understanding both scientist and practitioner want by showing how to bring about particular types or amounts of communication.

Despite their value, causal explanations are not sufficient, because they do not adequately characterize the relationship of communication content or process with outcomes and effects. Let us suppose that certain types of discussion content can be shown to be more conducive to quality decisions than other types of content. If we wish to explain that relationship, we are attempting to determine the purpose of favoring those types of content to others. This is an attempted answer to a question about the function communication plays in the achievement of desired goals and calls for a theory incorporating a functional explanation of the relationship between communication and decision quality. This is what recent functional approaches to this relationship have attempted to supply (Gouran, Hirokawa, Julian, & Leatham, 1993).

Thus, if we envision improvements in practice as a goal of communication scholarship and scientific theory as providing us with the means to that goal, we reach the following conclusion: We wish to propose theories that tell us how to reach desired outcomes through the manipulation of generative mechanisms that influence group discussion content or process. Theory providing functional explanation is needed because, in showing how communication functions to bring about the desired outcome, we discover what discussion content or process we need to bring that outcome about. Causal theory is needed because, in showing how generative mechanisms contribute to certain types of communication content or process, it tells us what types of interventions we need to bring about the type of discussion we want. Therefore, the two types of theorizing are complementary. Assuming the robustness of the functional linkage between desired outcomes and communication, to the extent to which we understand the structures and processes underlying the causal linkage between generative mechanism and communication, we have the potential to control our outcomes. To the extent that we can manipulate the causal linkage, we have actual control over outcomes.

Obviously, communication itself ought to play a critical role in these explanations. This role differs between the two explanatory types. In causal explanations, communication is a phenomenon caused by more fundamental structures and processes and serves as a conduit in a causal process linking these fundamental structures and processes to outcomes. In functional explanations, communication serves as a prerequisite for some outcomes rather than others. Arguments have been made that, because communication itself has no causal powers, it can be eliminated in causal theorizing (Hewes, 1986, 1996). However, a complete explanation of a causal process requires an examination of both generative mechanisms and enabling intermediaries. Thus, a determination of the role of communication as a conduit in causal processes is critical for the scientists' desire for understanding the relationship between generative mechanisms and outcomes and for the practitioner's quest for practice-relevant principles.

In the following pages, I consider in turn two "explanatory forms" prevalent in communication theorizing—one functional ("structural-functionalism") and the other causal ("input-process-output" models)—and describe examples of each from the communication literature. In so doing, I am not making the claim that these are the only valid theoretical forms in communication science; they are not. For example, dialectical explanations for discourse (Baxter, 1988; Rawlins, 1989) do not fit under either form. I am, instead, contending that these are two of the more prevalent forms and, when taken together, are sufficient for the purposes of the communication practitioner.

Structural Functionalism

Structural functionalism is an exemplar approach to functional explanation. It was originally devised by seminal anthropological theorists Malinowski and Radcliffe-Brown and began influencing sociological thinking primarily through the work of Parsons. Structural functionalism is not a theory. Rather, it provides a framework delineating the necessary parts of a functional theory about social systems. Following from Fontes and Guardalabene (1976), this framework consists of (a) the parts of the system, (b) the goals of the system, (c) the "functions" (behaviors) that keep the system moving toward its goals, and (d) the "structures" (attributes) of the system that perform these functions. The theorist then fills in the framework with content relevant to the particular type of social system under examination.

As a consequence of Parsons's influence, structural-functional thinking was applied to the small, task-oriented group during the latter half of the 1940s (Benne & Sheats, 1948). A general structural-functionalist approach to the functioning of a group consistent with the framework would be something like this:

1. Groups consist of people involved in interdependent activities.
2. Groups have a set of goals.

3a. To reach these goals, the performance of certain functions, generally instantiated through communicative acts, is necessary.

3b. Certain other types of communicative acts serve as counteracting factors making goal achievement less likely.

4. Social structures called "roles" must develop within groups to ensure that the necessary functions are performed and that counteracting factors are overcome.

Bales's (1953) application of this general model is, as far as it goes, a paradigmatic example. For Bales, groups have two goals: survival (maintenance) and task performance. Maintenance requires group cohesion and is enabled by communicative acts performing "positive socioemotional" functions, such as stating agreement, releasing tension, and showing solidarity among members. Task performance requires constructive conflict and is enabled by communicative acts performing task-oriented functions, such as asking for and giving information, opinions, and suggestions. To ensure that these functions are performed, task and maintenance leadership roles must develop. The problem in Bales's view is that an inherent contradiction exists between the two goals. Conflict, even when constructive, leads to tension that can damage cohesiveness and threaten group maintenance. Further, communicative acts counteracting group maintenance ("negative socioemotional" acts, such as stating disagreement, displaying tension, and showing antagonism among members) can further damage cohesiveness and maintenance. The performance of positive socioemotional functions relieves tension and is thus vital to group maintenance, but too much attention to maintenance stifles constructive conflict and threatens task performance. As one consequence, successful groups are those that develop a "healthy" equilibrium between task- and maintenance-oriented discussion by alternating between the two. As a second consequence, the same person cannot perform the task and maintenance roles because the task leader is perceived as the instigator of conflict and thus disliked by other group members.[4]

Missing from Bales's account is a discussion of any general principle underlying the hypothesized functional relationships. In fact, when Bales mentioned factors that could potentially serve as that principle, such as group member personality, culture, and preexisting status structures, they are described as possible reasons why groups differ from normative group functioning rather than reasons for the norm itself. Analogous accounts of general principles are also absent from current functionalist thinking in group discussion theory. For example, Gouran et al. (1993) presented both a model of group functioning consistent with the general framework above and a list of assumptions undergirding this model, but no explicit discussion of a general foundational principle. In contrast, critics of their essay (Billingsley, 1993; Stohl & Holmes, 1993) noted that two of Gouran et al.'s assumptions (that group members "are motivated to make an appropriate choice" and possess sufficient "intellectual capabilities" to perform the task) define that very principle. This general principle is presumed in Dewey's (1910) reflective thinker, an influence cited by both Gouran et al. and Bales (Bales & Strodtbeck, 1951). In more recent work, Gouran and Hirokawa (1996) began to examine the consequences that follow when group members fail to meet the rationality principle. A detailed explication of the principle itself, however, is still missing, and in my view is needed to complete the functional explanation to which these authors aspired.

Bales (1953) characterized the small discussion group as a cybernetic system, one whose behaviors function so as to maintain the system close to an ideal equilibrium. Bales's use of the structural-functional explanatory form in this case was no coincidence; when a social collectivity is viewed as a system, its behaviors are best accounted for through functional explanation. Attempts to view other types of relationships as systems cry out for accompanying functional explanations. For example, families are described as cybernetic systems at various points in Watzlawick, Beavin, and Jackson's (1967) classic work, and their behavior perhaps can be accounted for through an equilibrium model analogous to that Bales proposed for task groups.[5] In this case, it seems that the analogies to task and maintenance functions here are symmetrical and complementary interaction patterns in marital interaction: Both are necessary at times, but too much of a predisposition to either leads to relational problems, and alternating between the two (using Wilmot's, 1975, terminology, a "parallel" pattern) results in a satisfactory balance.

Watzlawick et al. (1967) made it plain that they were laying out a foundation on which interaction-based theorizing could be based, rather than the content of any one theory. More than 30 years has passed, and, although a relevant research literature has accumulated (Millar & Rogers, 1987), to the best of my knowledge no relevant theoretical accounts have been proposed. Because the behavior of social systems is best explained through functional accounts, I tentatively submit the following Bales-like possibility as a first crack:

1. A marriage (or similar long-term, committed relationship) consists of two people involved in (very) interdependent activities.

2. Marriages have two goals, task performance and maintenance.

3a(1). To reach the goal of task performance, the person most competent at that task must take the dominant position and the other the submissive.

3a(2). To reach the goal of maintenance, both people must have the opportunity to take the dominant position.

3b. As a consequence of attempting to reach these goals, competitive symmetry (fights over dominance) will occur.

4. Parallel interactional patterns must develop within groups to ensure equilibrium between both goals maintained and the effects of competitive symmetry counteracted.

This account seems to rest on an underlying principle of people as rational yet having some need for power. I want readers not so much to take this proposal seriously as to consider seriously the need for functional explanation of interactional communication patterns.

The Input-Process-Output Model

The input-process-output (I-P-O) model is an exemplar approach to causal explanation in communication. Although analysts have explicated the I-P-O model only relatively recently (Gouran, 1985; Hackman & Morris, 1975), it has been the traditional form for causal explanation in small-group discussion theory since its beginning. In that context, the model describes the causal process by which the manipulation of factors conceptually prior to group discussion (such as knowledge of and motivation to use reflective thinking) affects the content of group discussion, which, in turn, affects factors conceptually subsequent to group discussion (such as decision quality). The I-P-O model makes the linkage between scientific and practical concerns very clear. First, it describes causal process: Input brings about communication of a given amount or content, which brings about outcomes. Second, it provides general guidelines for practice: If you want communication of a given amount or content, you should manipulate input in such-in-such a way. Because of these dual concerns, I-P-O models are clearly desirable, and the group discussion literature includes several overt examples (Hewes, 1986, 1996; Jarboe, 1988; Salazar, Hirokawa, Propp, Julian, & Leatham, 1994).

What has not been recognized is the pervasiveness of covert I-P-O models throughout communication scholarship. The following is a smorgasbord of examples, chosen to highlight the variety.

Lexical Variation. Bradac, Bowers, and Courtright (1979, 1980) proposed an I-P-O model describing the effect of three aspects of lexical variation in a source's message (intensity, immediacy, diversity) on a receiver's judgments of the source (most notably, competence and source-receiver similarity) and the receiver's attitudes toward the issue expressed by the source's message. The source's degree of "cognitive stress" (input) serves as the main generative mechanism determining the source's message characteristics (process), which in turn affects the receiver's judgments and attitudes (output) both directly and in interaction with other receiver characteristics, most notably the receiver's perception of agreement with the message content. This results in the receiver's looking favorably on the source and the message content when the source is either (a) under high stress and delivering a message with which the receiver disagrees or (b) under low stress and delivering a message with which the receiver agrees.

Comforting Messages. Work by Samter and Burleson (1984; Samter, Burleson, & Basden-Murphy, 1989) implies an I-P-O model of the genesis and impact of comforting messages. Message sources are conceived as differing in their degree of "cognitive complexity." Those higher in cognitive complexity (input) are seen as more capable of, and more likely to produce, relatively complex messages (process) that perform several functions (e.g., express remorse for and empathy with the target's suffering along with suggestions of subsequent actions for the target to consider) than those lower in cognitive complexity. More complex messages lead to the target's feeling better and forming a more positive and complex impression of the message source (output).

Time Pressure in Group Task Work. Karau and Kelly (1992) described an I-P-O model of the impact of the amount of time a group has to complete its task on group discussion content and group performance. All else being equal, time scarcity will lead to a greater proportion of discussion aimed at task rather than maintenance or irrelevant content. In addition, as groups under time pressure are more concerned with task completion than performance quality, verbal evaluations of proposals will be relatively more positive than in groups with more time. As a consequence, for tasks in which communication is relevant to performance, groups will work faster under time pressure, but performance quality will be higher when time is abundant.

Organizational Performance. As a consequence of findings from surveys of organizational managers, Likert (1967) proposed a model of organizational performance approximating an I-P-O format. The degrees to which the members of an organizational unit share high performance goals, maintain mutually supportive relationships, and engage in participative decision-making were seen as causal variables determining such intervening variables as degree of loyalty to the organization, confidence and trust in one another, reciprocal influence, and amount of communication. These, in turn, affect the end-result variables of worker absence and turnover and organizational productivity and profit. The theory is unfortunately marred by Likert's failure to distinguish cognitions (loyalty, confidence, trust) from behaviors (influence, communication); only the latter are truly intervening.

In addition to these and analogous proposals, some more process-oriented theories can be interpreted within the I-P-O framework by including feedback loops from output to input. In the original version of uncertainty reduction theory (Berger & Calabrese, 1975), strangers begin an initial interaction with high uncertainty about one another (as input), motivating information seeking and high reciprocity (process) that lowers initial uncertainty (as output), which (as input) in turn leads to increased verbal- and nonverbal-affiliative behavior (process), lowering uncertainty (as output) some more. In interpersonal deception theory (Buller & Burgoon, 1996), a deceptive sender's knowledge, skill, and goals (input) interact to determine a behavioral display (process) that is perceived by a receiver and (based partly on the receiver's knowledge and goals) judged for degree of veracity (as output). This judgment (as input), along with the receiver's skill, affects the receiver's behavioral display (process), which the sender then judges for signs of deception detection (output), influencing the sender's next behavioral display. The coordinated management of meaning theory (Pearce & Cronen, 1980, chap. 5) also fits this formula: One person's knowledge of regulative rules (input) determines that person's utterances (process), which another person interprets using a knowledge of constitutive rules (output), which helps the person decide which regulative rules (input) determine that second person's response.

All of these theories suffer to a greater or lesser extent from a lack of detail concerning the operation of the relevant generative mechanisms. The structures and processes constituting "cognitive stress" (Bradac et al., 1979, 1980), "cognitive complexity" (see, for example, the discussion in Burleson & Caplan, 1998), "uncertainty" (Berger & Calabrese, 1975), "rules" (Pearce & Cronen, 1980), and the various factors in the models of Likert (1967) and Buller and Burgoon (1996) are not described with sufficient information to allow for potential control. Karau and Kelly (1992) rate somewhat higher here, with a relatively detailed discussion of the role of "attentional focus" in the time pressure-group discussion relationship. In contrast, one can find detailed discussion of relevant generative mechanisms for communication in some other proposals, such as planning theory (Berger, 1997), action assembly theory (Greene, 1984), and nonverbal expectancy theory (Burgoon & Hale, 1988). These are, however, best described as "input-process" theories, with little attention paid to the outputs enabled by communication. Perhaps they can be linked, if only informally, with accounts of the functions that relevant verbal and nonverbal actions can perform.

In Defense of the Proposal

In this essay, I have argued that a scientific explanation is a discursive activity meeting a set of content requirements that distinguish it from other types of explanation. I have discussed causal and functional types of scientific explanation and one specific form of each type (input-process-output and structural-functional, respectively) as prevalent examples in communication theorizing. I also have claimed that theories instantiating the two forms, working in tandem, can provide the knowledge that people desire to empower themselves and reach their goals in both public and private settings. I close this essay with a few comments intended to address some of the criticisms that might be directed at these positions.

One of the legacies of the philosophic tradition started by Wittgenstein (see, for example, Burke, 1966, and Harre & Secord, 1972) is the notion that human behavior can be divided into two categories: that which is volitional (action) and that which is not (motion). One cannot doubt that the possibility of volitional behavior sets the human apart from most other objects, and that our attempts to study the human must always be informed by that possibility. It is at least conceivable that the gap between action and motion is so large that the two require fundamentally different types of explanation. Many past commentators believe this to be the case (e.g., Harre, 1974; Taylor, 1970; Toulmin, 1970). The arguments I have advanced are predicated on the belief that it is not. This belief is founded on the following notions (see Kaplan, 1964, for their genesis).

First, scientific explanations, and the theories with which they are associated, are by their very nature attempts to generalize beyond the individual case. Thus, they rely on commonalities among the objects to which they are relevant. It is true that a unique set of psychological characteristics serves as the foundation for our actions; our goals, beliefs, and intentions define each of us, so to speak. Does that fact establish that human behavior is impervious to scientific explanation? No more than the other objects of our experience. To use one example of an object lacking volition, every rock is a unique combination of physical characteristics that serve as the foundation for its motions, for example, its size, shape, and density.[6] It is the commonality of types of attributes—physical for rocks, both physical and psychological for people—that provides us with the opportunity to generalize and thus potentially explain. In other words, all rocks have size, shape, and density. All people have those also but, more importantly, they also have goals, beliefs, and intentions. In each case, these and analogous attributes afford us the grounds for scientific explanation.

Second, saying that much of human behavior is volitional is in essence saying that much of human behavior is a consequence of the beliefs that particular actions are reliably associated with particular outcomes and the often-resulting intentions to achieve those outcomes through performing those actions. Most action philosophers (Bratman, 1990; Goldman, 1970; Searle, 1983) conceive of intention and belief as joint causal agents for action and, thus, of action as amenable to a form of causal explanation. Although such explanations would not meet our criteria for "scientific" (for one thing, they are specific to the individual rather than general), their feasibility is strong evidence against any arguments that causal explanation is irrelevant to human action.[7]

Third, as discussed earlier, the human capacities for self-awareness and self-determination mean that the concept of "control" has a substantially different meaning in the human sciences than in the physical. What is more, these human capacities allow the person knowledgeable about explanatory scientific theories to apply that knowledge in planning his or her actions. The more understanding average persons have of the causal influences on and functional results of their actions, the greater is their capacity to reach their goals in spite of any forces of influence around them. For those still questioning the implications of "control" for the human sciences, Greenwood (1991) has a good answer:

> Interventions based upon causal knowledge that extend human powers and eliminate or alleviate human liabilities increase the capacity for self-control of actions by lay agents, rather than increasing the capacity of social psychological scientists to control human actions. In consequence, the practical interventions of social psychological scientists generally render human action less predictable than before, by opening up new possibilities of action for agents. (pp. 79–80)

To repeat, communication theories boasting potential control can be empowering to the individual and, for this reason, one of the greatest contributions we can make as communication teachers is to provide our students with as great an understanding of the breadth of scientific explanatory theory as possible.

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Notes

[1] There are other reasons, most notably the fact that, contrary to perspectivist claims, scientific theory clearly reflects an ever more accurate picture of the world. After all, Aristotelian physicists could never have gotten us to the moon, whereas Newtonian physicists could and did.

[2] Unfairly, I might add. The principle of reduction in logical empiricism actually stated that all sciences should in principle be capable of being translated into the sense-data language of physics, not that this was either possible in fact or desirable in practice. The point was to show the unity of description across all sciences (Turner, 1965).

[3] Part of Hume's argument about causal statements was analogous to his argument against inductive generalizations: One cannot justify a statement about causal necessity because it cannot be proven universally true. The response is similar: Simply because it cannot be proven does not mean it cannot be justified through the presentation of good reasons. Hume has also been criticized for relying too much on the sense of sight in his argument and, in so doing, neglecting strong evidence for causal forces detectable through other senses.

[4] This second hypothesized consequence is almost certainly wrong; see Turk (1961) for a counterexample.

[5] In fact, Parsons and Bales (1955) conceived of family functioning in ways analogous to Bales's model for groups and once again erred in hypothesizing that family task and maintenance leadership must be performed by different, and in this case gender-stereotyped, parents (see Swensen, 1973, for a review of relevant criticisms).

[6] Actually, it is the nuclear physicist who has it easy because all electrons are basically identical.

[7] It is the capacity for human choice, and not the choice itself, that is amenable to scientific explanation.

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