# APPLICATIONS OF COMMUNICATION THEORY: V. PLAY-THEORETICAL ASPECTS OF SCIENCE

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## INFORMATION THEORY

I approach communication from a behavioral science standpoint, and this, it seems to me, requires that sharp distinctions have to be drawn between communication and information concepts. Almost all research up to now in this area of concern has been about information, how it flows from one person to others, how it fares in libraries, journals, abstracts and the like. The generalized system is modelled by the telephone, with information source, transmitter, channel, receiver and destination (Raisbeck, 1963). Behavioral scientists introduce encoders and decoders (Schramm, 1955; Berlo, 1960), but the concern is still with information flow. A review of literature by Paisley (1965) considers how information flows, how it is used, how scientists keep abreast of current information, how they make sure that information is reliable and so on: in pursuit of such studies more than 30,000 scientists and technologists here and in Britain have been interviewed or surveyed in recent years. I am to propose, nevertheless, that little of this concerns communication from a behavioral science standpoint.

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This is not to say that I am unaware of the vast significance of information in the world of science, or of the importance of looking at this from a behavioral science standpoint. Nor can there be two minds about the deepening crisis that the exponential rate of growth of information in science is presenting, a situation that is aggrevated by the changing patterns of information flow in science and technology. As Paisley (1965), Overhage (1968) and others attest, scientists (and I shall hereafter include technology in the science rubric unless otherwise indicated) are relying increasingly upon interpersonal avenues of flow rather than upon the old-time formalities of definitive papers. The *modus operandi* of information flow is now significantly a matter of long-distance telephoning, conferences, site visits and the like. Much current information is a chaotic mass of symposium discussions, departmental bulletins, government reports, preprints, informal papers and so on, very different in place and quality from the orderly papers which find their way into well-regulated scientific journals. The American scientist is now the "affluent commuter" (Price, 1963), and universities speed the information flow with private air travel, laid on to every progressive campus.

Meanwhile libraries find themselves without the bibliographic methods, even if they have the means, for bringing order into the new patterns of flow (Overhage, 1968). Nor is it certain that modern electronic equipment for storage, retrieval and flow will improve matters: for some time, at least, confusion may be added to chaos.

One has to ask what behavioral science can hope to contribute to this area of concern. That there is important work afoot from this standpoint one need not deny: the American Psychological Association's studies of the patterns of information flow in psychology are a case in point (Garvey & Griffith, 1964). The Shilling, Bernard and Tyson (1964) study of biochemists provides another example: these authors found that unrestricted long-distance telephoning by

biochemists correlated highly with success in obtaining information but not with productivity (a delightful *sequitur*). Unrestricted travel correlated highly with both productivity and efficiency. Payments of expenses to conferences, however, were not a strong correlate of either the productivity or the efficiency of the biochemists. And the use of paid consultants was contraindicated--it correlated negatively with productivity and efficiency. Amusing though these results are, and however interesting they may be to university administrators, they are not evidence for anything of any theoretical import: they are not evidence, for example, that the new patterns of information flow are better in certain theoretical respects than the old-time reliance upon definitive papers. Moreover, when a careful look is given to the studies undertaken during the past 25 years, serious doubts arise about them in methodological and other respects. The one generalization that is strongly supported according to Paisley (1965: 8) is that "all information-processing behaviors vary--from country to country, sample to sample, subgroup to subgroup, person to person." Another conclusion, again according to Paisley, is that most of the studies are suspect for one reason or another: differences in questionnaire design, in objectives, in sampling procedures, in data-collecting methods, in response rates and so on make it impossible to draw any safe generalizations. If so, it would seem premature to conclude so strongly that information-processing behaviors vary so greatly.

What is more unsatisfactory, however, is the absense of a theoretical basis for these studies. There are mathematical metatheories for information flow, stemming from Shannon, but these are not used in the studies reviewed by Paisley except in systematic studies of journal-to-journal coupling and the like (e.g., Xhignesse & Osgood, 1963). Otherwise the studies are all of an *ad hoc* nature, directed by practical and not theoretical considerations. Even if future studies were put on a theoretical footing, however, though this might interest engineers it

would miss what should be of primary interest to behavioral scientists, a matter to which attention is now given.

## COMMUNICATION THEORY

The primary concern should be with communication in certain play aspects, and not with information flow.

When I raise my hat to a lady and greet her with "Good morning: it's a nice morning," I am not passing information to her about the weather. I am being sociable, courteous and gentlemanly according to custom. The lady will probably nod graciously in return. The behavior is an interchange of attitudes, like acting on a stage, and a great deal of communicative behavior is of this nature. Conversations between friends are ordinarily attitudinal though we are apt to overlook this in our highly rational society and think of conversations as interchanges of ideas. Of course some information may flow, but the model for gossiping is play-acting, as in a theatre, and certainly not a telephone system.

But science, it will be said, is concerned with the advancement of knowledge and not with postures and play-acting. Everyone knows, however, that scientists place considerable store upon prestige, fame, and fair play in connection with their publications and discoveries: they value priority of discovery (Merton, 1957). It has also often been observed that scientific research is in many ways like a game in which problem-solving, like puzzle-solving, has a distinctly playful character (Kuhn, 1962). The papers presented by scientists to journals are seen by Hagstrom (1965) as gifts of information given in exchange for recognition by their colleagues--the gift-giving has almost a tribal character. It can scarcely be denied, therefore, that science has play-like elements in it. It will be said, however, that these are incidental to the main course of science, and that scientists have at heart the advancement of science more than their own prestige or recognition.

If it is admitted that in a general way this is the case--notwithstanding the exceptions to which anyone may draw attention--one would still be overlooking the real problem. This is whether science isn't, after all, far more a matter of communication-pleasure (Szasz, 1957), of communicative behavior, profoundly and not merely incidentally, than anyone has supposed up to now.

At least if the distinction is drawn between communication in science and information flow, the former being a social-interactional, cultural, matter and the latter not, it may be possible to put into better perspective a great deal that has been written about the effects of science and technology on the world, for example by Ellul (1964), as I shall indicate.

It has to be admitted that communication theory is in its infancy. My play theory (Stephenson, 1967) takes a first step towards it, beginning with the empirical study of mass communication because that is where play (the acting, entertainment, gossip and the like of television, newspapers, radio, etc.) is most evident. But the theory applies to social interaction more generally, for example in politics, the law, and in much else, including science.

The concern is not with game theory. Nor is the involvement with people's attitudes about anything. The concern is with behavior, much of it subjective to the person. In the case of the mass media it deals with the behavior of people vis-a-vis television, radio, movies, newspapers and magazines. The behavior is obviously more fun-oriented than information-oriented, more a matter of entertainment than of serious learning. The general term for such fun, enjoyment, and entertainment is *play*. The main theory, following Huizinga (1955), is to the effect that cultures function largely as play. I add the converse, that what is *work*, as such, is *a*cultural--in the last analysis all work could be automated (Stephenson, 1967).

# VIRTUAL WORK

Our initial premise is that work is quite different from play. We work for a living but we play for fun. Of course we can mix these up and make work of fun, and fun of work. But it is important to distinguish work from play. Work involves transfer of energy, usually in relation to work done, measured in science as foot-pounds, ergs or joules. In science the distinction is drawn between work and virtual work, there being no work done in the latter case. Virtual work, as is well known in science, is a conception of a system of particles in equilibrium under the action of a set of external forces; the total work done by these forces when the elements undergo small displacements is zero. The expression for virtual work is the familiar summation:

$$\sum_{\partial}^{n} F_{ie}\, dr_i = 0$$

(where the force on the $i$th particle is $F_{ie}$, and $dr_i$ is its virtual displacement: the summation is over all $n$ particles of the system). I am proposing that play can be conceived abstractly as virtual work. Play is under constraints, under impressed external forces of many kinds (rules, fair play and the like) but from a work-done standpoint nothing gets done. Thus the mountaineer climbs a mountain and works prodigiously in foot-pounds: but from the play-theoretical standpoint this is entirely incidental to the fun--what matters is the glory of standing on the mountain top, the winning of the contest against natural hazards of the most dangerous sort. To represent this requires the principle of virtual work for its understanding.

What I have in mind is more than an analogy: there is a direct isomorphism between virtual work and play, and the concept helps us to think more clearly about much behavior that is mistaken for work when in fact it is play.

For the moment, however, the distinction between work that gets things done for a purpose and play that gets nothing done except for the fun of it, takes on special interest when it is recognized that cultures (such as cultural anthropologists discuss, and such as C. P. Snow (1963) had in mind in his famous animadversions upon science and the humanities) also require the concept of virtual work for their understanding, and that science and technology in so far as they get things done are not cast in this cultural mold. Technology, certainly, gets things done, and science, everyone admits, is bringing about vast changes in the world. What the consequences are for culture is quite another matter. What science brings about may be terribly disintegrative, as Ellul (1964) has supposed. Or, mere achievement may be at issue as work done, as some studies already suggest (e.g., McClelland, 1961). On the other hand if much of the behavior of scientists can be shown to be virtual work then to this extent it could fit the culture mold, and this would be very interesting indeed.

It is worth repeating that there is a great deal of play in science, as Hagstrom (1965) most notably indicates, and as many, including Merton (1957) and Kuhn (1962) have also shown. Paisley (1965), and Scott (1959) before that, have observed that happenstance has a significant role in the behavior of some scientists: discoveries come as much from idle browsing in library stacks as from deliberate thinking or research. Overhage (1968) maintains that this is among the "happiest and most valuable" of a scientist's experiences. Browsing is a "milling" form of behavior, common on beaches, in the scanning of magazine articles and much else. There is a certain enjoyment in such behavior in *not* doing work, in *not* being deliberate, logical, purposeful or "really scientific." Serendipity is obviously more comical than logical. Of course, it is always easy to spoil the enjoyment by scheming, by not playing fair, by being too serious about what, after all, is meant to be fun. And it is possible that scientists, in particu-

lar, are more spoil-sports than they guess or than they perhaps should be: for scientists, as for Americans, achievement *per se* may be the thing, *de rigueur*, and not the fun of it.

All of this we can consider and accept. But it does not say how for science *in esse* is more play than work, and this is the essential problem.

I am not, of course, about to argue that there is no information flow in science: but it would seem important to distinguish between flowable information in terms of which things get done in science, and virtual work in terms of which science, shall we say, is, or could be, having fun. It may be something of a shock for scientists to face this distinction: but the implications are surely very interesting and probably very important. The difficulty was to provide a basis for systematic studies of communication regarded as play, a problem I believe I have solved in my play theory (Stephenson, 1967). It is not easy, at first sight, to grasp what this has to show for itself: but one can proceed by example. It is interesting, therefore, to see what the theory leads to in the case of a specific study on communication in science.

## PUBLIC SCIENCE COMMUNICATION

I would like to give a reminder that my concern is with empirical and not with philosophical matters. A beginning can be made in the process of distinguishing between communication and information in empirical respects by examining the problem of how the general public becomes involved in science. A paper by Tannenbaum (1963) entitled "Communication of Science Information" deals with this matter from the information-theory position. Tannenbaum studied the fate of science information as it flows from a source (assumed by Tannenbaum to be the scientist) to the science writer ("whose task is to translate the scientist's message into terms that the public can understand"), thence to the newspaper (or other) edi-

tor, and finally to the public. The study indicated that whereas scientists and science writers give a truthful account of things (which the public would prefer to have), editors change what the science writers give to them to make it more palatable (the editors suppose) for public consumption. The facts reach the public, therefore, in more or less distorted, erroneous, or misinterpreted forms.

Tannenbaum had to suppose that editors did not understand science, but it is hard to believe that they are ignorant also about the public. What matters to scientists, no doubt, is *what* is in the newspaper or on television. *How* it is said (or presented) is of concern to the science writer. The public, however, may care for neither what is said nor for how it is said. Johnson (1961) indicates as much, and Patterson (1966) draws the same conclusion, that the public gives little saliency to science in comparison with much else in everyday life, for example to economic conditions. One suspects that editors know this very well, or sense it as members of the general public. When Sputnik soared into the heavens, that was news; when three astronauts died in their capsule, that was news. Editors do a pretty good job with such heaven-sent events. But the public couldn't possibly become informed about the trillions of facts put out by scientists in the ordinary course of events. Thistle (1958) estimates that only one ten-thousandth of one percent of current information could conceivably reach the public, and that is obviously a gross overestimate. Who, from this vast mass, is to decide what is to flow to the public? Consideration of information flow is absurd until a basis of selection is available for what is, and what is not, to flow.

Communication theory, in play-theory terms, provides the required basis. It does so by discarding Tannenbaum's chain of information flow, from scientist to public, and by assuming instead that the public already talks about science in conversational respects, and that what it talks about, or could talk

about, though it could no doubt be improved upon, suffices in principle for its communication purposes, that is, for social interaction in virtual work, play-theoretical, terms.

The concern, therefore, has to be with understanding what the public already has in its mind about science, not as information but in communication respects, and to see how this and science itself can best be brought together, not to bring about better or more information flow but for more of what is culture-forming.

This no doubt presents difficulties for scientists to accept. It will be said that if a person isn't sufficiently informed, how can he hold responsible viewpoints about a matter? The public, however, can be made aware of the great place of science in the world without adding to its store of science information by any significant amount. It is a fallacy of the information theorists (as it is of many educators) that the more information one pumps into a system the better for it. On the contrary, the public is likely to fasten upon a few simple themes, which suffice for communication. Of all the hundreds of scientific facts concerning the manned space flights, probably only one theme remains firmly in the public mind--the so-called "walking in space."

From time to time there will be Sputniks, cancer cures, dead astronauts and the like, about which people will have communication in almost any circumstance or situation--at work, in the home, and anywhere. These are communication godsends. The mass media also contrive science "news," such as "human interest" stories about stamp-collecting chemists, baby-sitting astronomers, art-loving biologists and the like. There is the flavor of science in all of this, of course, but surely much more of simple fun, excitement, wonder, drama, interest, tragedy, amusement and, in a word, of play than anything of factual import.

But who, it will be said, is to interpret science to the public, to show its deep significance for mankind, the breadth of its outlook, the deepening understanding it provides, the culture it contains? Indeed who is to interpret such matters to scientists as well as to the public? This nation is spending enormous sums on research and development--far more than any other nation. Can the public have anything to say about this, or about how much should be spent on medical research, and how much on high-energy physics? What will it have to say about the advances, soon to astonish us, in genetics?

## COMMUNICATION PLEASURE

The questions are answered, in communication terms, by noticing that all are matters of opinion, of beliefs, values, faiths, and ideologies rather than matters of fact. About these, therefore, almost anyone can speak his mind, and are not one man's views about as good as any others? Conversations about all such matters, like bull sessions in general, are amongst the best of human pleasure. What could give greater delight than to dilate endlessly on these questions over a glass or port or a bottle of beer? All such is the stuff of communication. All such is communication-pleasure (Szasz, 1957).

What is important in such communication is a certain simplification and dramatization of simple themes and strong symbols, as well as repetition over and over again of what is familiar. This is well-illustrated by movies, which provide an excellent model for all communication and all play. Movies are enjoyable in all cultures. It is characteristic of them that they involve very few themes, which are repeated in one movie after another. In France it is the theme of the prostitute reformed (from red light to la haute Marquess). In the United States it is the affair of the good-bad girl, and the theme of the son who out-achieves his father. In pre-Nazi Germany the son returns, beaten and chastened, to lay his weary head on his mother's ample bosom (Wolfen-

stein & Leites, 1950). The "bowed blond head" of the heroine is a recurring theme of English movies--the Englishman seems bent on destroying the woman he loves. Movies, like the fairy-tales told to children, repeat simple, vigorous themes, with strong symbols, on top of which every artistic nuance of actors, directors, writers, producers, and photographers find expression. What results is enjoyment, even with tears. The communication serves no useful (work) purpose other than to be entertaining, and except to give people something to muse about or to talk about in conversations. It is entirely virtual work, except perhaps for a slight heightening of one's self-esteem when a movie has been especially self-involving. It may be self-enhancing, but only within the confines of one's own imagination, in the secret places of one's mind.

So it is with all entertainment and play, from the simplest to the most complex of its forms. What else is there for the mountaineer but self-enhancement as he stands, triumphant, on the mountain top?

Methods now exist for objective determination of these themes: my play theory (Stephenson, 1967) offers at least a glimpse into these. It is scarcely incidental that I have also provided a new basis for the measurement of public opinion (Stephenson, 1964). And is it not reasonable to suppose that the more people can enter into communication-pleasure about nuclear armaments, about the accomplishments of science, and about the place of values in the world of facts, the better for science in its public cultural aspects? And does it really matter very much *what* is talked about? It is all the better, theoretically, if it is not taken too seriously, is non-partisan, doing no one any harm and no one much good, except in the confines of one's self. Every now and then, no doubt, facts will obtrude, but this will almost be by chance. To the extent that people are able, free and interested to converse about science from their own viewpoints, however erroneously, and outside all work considerations, to that degree will science be a

matter of public culture and enjoyment. None of this can be understood in terms of information or of information flow. It is understood, instead, in terms of culture that is *played*. This is what was seen in the eighteenth century when cultured ladies and gentlemen conversed freely with a Lavoisier or a Priestley in the *haut salon*. It is what was seen in the seventeenth century in the common talk of the princes, prelates, gentlemen and traders who bought Galileo's *Dialogue* on the black market, at black market prices, for the excitement, naughtiness, and enjoyment of it, apart altogether from the facts it so elegantly described (de Santillano, 1955), which few could really understand. It could be much the same today if attention is turned from information and how it flows to communication and how it is played.

Of the three modes of communicating material, that which is heavensent (Sputnik and the like), that which is contrived (the "human interest" stories), and that which deals with themes nascent in the public mind, the latter is by far the most significant for public communication: yet nothing is being done about it in any systematic sense.

## PLAY THEORY OF SCIENCE

There remains the crucial question: how far is science more play than work? The concern is not with the obvious matter that scientists enjoy what they do, or that problem-solving in science and puzzle-solving amongst children have much in common, both being playful. The concern instead is with the profound possibility that scientists are playing at science and don't realize it. Nor is this a matter for reproach. On the contrary, if it is true, it puts science four-square with all the cultures. Fundamentally, science, but not technology, is a matter of play. To develop this theme requires separate treatment, to which I will devote future papers.

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