Interdisciplinary Dissemination of Aerospace Technology - A holistic Approach

Louis S. Berger
Southwest Research Institute

Follow this and additional works at: https://commons.erau.edu/space-congress-proceedings

Scholarly Commons Citation
https://commons.erau.edu/space-congress-proceedings/proceedings-1969-6th-v1/session-12/4
The ideas which I should like to present were stimulated by the tasks posed to us as members of a Biomedical Application Team sponsored through NASA's Technology Utilization Program. It therefore is appropriate to set the stage by a brief description of the Biomedical Application Program's goals and methodology. These NASA programs were established at three institutions, Midwest Research Institute, Research Triangle Institute, and Southwest Research Institute, to help bring about a highly desirable but difficult to accomplish aim, namely, to transfer applicable aerospace generated research products to the field of biomedicine. Suitable ideas, concepts, techniques and designs were to be sought in all varieties of aerospace research programs. It was an important premise of the project that the quest for biomedically useful technology not be restricted within biologically oriented research programs. That is, our special challenge was to locate biomedically applicable technology among the products of research carried on in areas which might at first glance seem to be totally unrelated to biology. Indeed, relevant research was on occasion discovered in remote technological areas. For example, one of the research hospitals associated with our project is currently engaged in an extensive program to evaluate clinical applications of a device originally developed at Langley Research Center as a reduced (lunar) gravity simulator.

This somewhat unusual "information retrieval" project task has forced us to grapple with fundamental problems in information science. We have accordingly been encouraged by our sponsor to spend a modest proportion of project time on basic studies in this area, and this paper reflects the results of our analyses.

A starting point for our discussion is the thesis that the unexamined, uncritical usage of words may cause extensive and unrecognized mischief. We grow up immersed in our language; it is so much a part of us that, to some extent at least, we are unable to recognize that it significantly affects the way we perceive the world.

For example, a recent journal article explores the way in which we perceive color. As might be expected, different cultures have different names for the various colors. Perhaps more surprising is the impact on the perception of these various color names; the differences in verbal labels induce the members of various societies to perceive colors in different categories — they carve up the visible spectrum in different ways. Not only do the color bound-

aries occur at different spectral locations, but the number of distinct colors that are recognized varies from culture to culture.

There is by now a substantial literature in the theoretical discipline of general semantics which amplifies this idea; several standard references are listed at the end of the paper.

It may not yet be apparent how this discussion relates to the problem of transferring information. Perhaps the relevance can be revealed by posing some familiar questions in the conventional way, and then trying to see to what extent we have prejudged the possible answers by our mode of questioning. Here are the questions in their customary form: What are the problems of transferring information? What is information? How do you store it? How do you retrieve it? And how do you properly describe the information content of a document?

In the light of the comments on the effects of language on perception, let us stop and look at the ways we have worded the problems. Isn't it possible that some of the difficulties of information transfer are due to the word "information" that is used and in the "thing-ness" that it implies? Consider these comments by Bois:

"The main trouble is that we often believe that what is going on is what we say is going on. It works fairly well in simple cases, but it often creates unnecessary problems. The hidden implications of what we say cause us to look for things that are not there. Poincare gives an example which has become classical: In the days when very few chemical elements were known, scientists were trying to isolate the element heat. Why did they look for heat as an element comparable to sulphur, oxygen, or mercury? Because it has a name that belonged grammatically (and therefore logically) to the same class as that of elements, the class of nouns or substantives. By implication, substantives referred to substances (or elements), and consequently, the scientists were looking for the substance heat, or phlogiston. But it was not there. Back of that substantive was a process, not a permanent element like sulphur, oxygen, or mercury. What the language said and implied was not what was going on."

Applying this point of view to our problem area, let us then assume that the word "information"
has the same limited reality as does the word "phlogiston." If this assumption has merit, it is possible then that we may be misled by accepting the reality of the entity of "information" without reservation: If it is a thing, something that the seeker of "information" is looking for, it should be extractable from documents, be capable of being labeled, stored, retrieved, packaged, and delivered to the consumer. We also are lead to ask questions such as: Who is best qualified to perform the various operations of extracting, storing, and retrieving it? What sort of systems and subsystems should we use to carry out the various subtasks which "obviously" need to be carried out? These are some of the questions raised if we ascribe material reality to the apparently innocuous word "information."

In addition, these kinds of questions even imply along what lines the systems which handle information should be designed: the notion in the documentation sciences that information is a thing which can be packaged and transported from originator to ultimate consumer suggests that information systems be designed around the traditional model of a goods transportation system: it suggests that a system which handles information be like other delivery or distribution systems, essentially unidirectional, designed to handle packaged goods which remain invariant while they are being maneuvered through the various way stations of the delivery (and storage) process.

This traditional notion of information has been useful, but we believe that the time has come to consider an alternative description and structuring of the "information transfer" activities: we propose to view the so-called exchange of information as an overall communications process, involving the originator of thoughts and "facts," various stages of symbolization and transformation of the originator's initial thinking, perception, and experience, and finally involving a user who must deal with some aspect of the symbolic communication. This reformulation in focusing on the communication aspect of the process provides a fresh basis for locating the true difficulties of the process and at the same time, suggests new approaches to old difficulties.

When we approach the "handling of information" as a problem in communication, our familiarity with impediments to the communication process in other contexts immediately can be applied here to reveal and define problem areas. For instance, since the area of symbolism is a notoriously troublesome one in the general field of communication, we would expect it to be a source of difficulty here also. In addition, we would expect to find problems related to the inevitable entropy-like deterioration of the original communication each time it is retranscribed; the symbols refer to broader and broader categories, and the specific structure of the original communication continually is degraded in this retranslation. We would also expect to encounter special problems when attempting "information transfer" across disciplines — in addition to the well-known language barriers, we would also anticipate communication barriers stemming from different professional backgrounds with their concomitant differences in attitudes, values, and problem solving techniques. Yet another problem area revealed by the communication approach is the area of constraints associated with the communication channels; we would expect that certain intrinsic features of a channel such as its single mode capability might impede the communication flow. As these examples show, the communication viewpoint is useful in structuring new problem areas.

A second significant advantage of this point of view for the information sciences is that we may expect to obtain help from disciplines that study communication. We would use the models, techniques, and insights achieved by social scientists, logicians, and others engaged in the study of communication processes to generate new approaches which would facilitate the exchange of knowledge. To cite a few examples:

We learn that good communication thrives on dialogue. We would therefore expect to derive extensive benefits from providing a system which somehow incorporated bidirectional communication channels.

Another feature of good communication is multi-modality. We therefore might consider using systems with parallel information channels, perhaps providing a combination of the traditional written form of notational mode together with an audio or video channel.

Incidentally, to refer once again to the NASA Biomedical Application Programs, I might mention that as we have been forced to cope with novel "information exchange" situations in these programs, we have intuitively gravitated toward the techniques just mentioned. For instance, we are beginning to experiment with some multimodal documents as possible replacements for the more traditional written document.

Finally I should like to suggest that some of the questions which have been mentioned here might with profit be investigated in more detail. First, how can communication be improved, and which disciplines should be consulted for guidance in this area? Secondly, how can we better define and cope with the problems related to the symbolism which is interwoven with the communication process? Third, how can we help the user of the system — the seeker of knowledge — to efficiently and effectively structure his quest? Finally, what are the systems implications of
viewing the process as one of communication? Can we develop unique types of systems for the various different kinds of communication exchanges which we encounter in the information sciences? It is hoped that these speculations and thoughts will suggest additional new approaches to the traditional formulation of the "information transfer" problems and that the reformulations which follow from the new point of view will ultimately lead to solutions to some old problems.

Acknowledgement

It is a pleasure to acknowledge the contributions, through many stimulating discussions, of my colleagues at Southwest Research Institute, particularly Drs. R. W. Ware, C. G. Gardner, and W. L. Anderson.

References:


General References:


Relevant Articles in the "Information Sciences":
