RELEVANCE: A Review of and a Framework for the Thinking on the Notion in Information Science *

Information science emerged as the third subject, along with logic and philosophy, to deal with relevance— an elusive, human notion. The concern with relevance, as a key notion in information science, is traced to the problems of scientific communication. Relevance is considered as a measure of the effectiveness of a contact between a source and a destination in a communication process. The different views of relevance that emerged are interpreted and related within a framework of communication of knowledge. Different views arose because relevance was considered at a number of different points in the process of knowledge communication. It is suggested that there exists an interlocking, interplaying cycle of various systems of relevances.

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● Preface: Where Lies the Importance of Thinking on Relevance?

From the small world of our everyday lives to the large world of mankind, the complexity and interdependence between the spheres of our lives and worlds has increased tremendously and so has our awareness of the ensuing problems. The problems of our civilization and "mankind at the turning point," as documented by Mesarovic and Pestel (1), the problems of post-industrial society as envisioned by Bell (2), and the problems of modern living and quality of life, as experienced by all of us, have one thing in common: to work toward their rational resolution, we need the resolve and wisdom to act. Knowledge and information are not the only aspects that create a resolve and instill wisdom. But they are important aspects. And the complexity of our present problems has probably made them into the most important aspect.

The effective communication of knowledge—effective information systems—thus becomes a crucial requirement for the resolution of a variety of problems. For different problems, different information systems (libraries included) have been developed or envisioned. Today most, if not all, information systems have one common demand thrust upon them: to increase effectiveness of communication and of services. For instance, the emergence of new services, such as urban information and referral services, and of new concepts in systems, such as information utilities and on-line information retrieval networks, can be directly traced to such a demand and to attempts at resolving some of the above problems.

In the most fundamental sense, relevance has to do with effectiveness of communication. Underlying all information systems is some interpretation of the notion of relevance. In this paper, I intend to explore the meaning of relevance as it has evolved in information science and to provide a framework within which various interpretations of relevance can be related.

Hopefully, the future thinking on relevance may be advanced within the suggested framework. The better we understand the meaning of relevance from different points of view, the better we understand various "systems

of relevance" [a term borrowed from philosopher Schutz (3)]—the better information systems could be built. In addition, the better we understand relevance, the better chance we have of avoiding failures and of restricting the variety of aberations committed in the name of effective communication. In that lies the importance of advancing the thinking on relevance.

• Introduction: How Relevance in Information Science Is Involved in Controversy and How It Is Interpreted in Other Subjects.

If I were to follow the tradition of much of the writing on relevance in information science, I would start with the often found statement that the understanding of relevance is wrought with controversy, that much of the thinking is muddled philosophical rambling and that the talk about relevance uses a bewildering array of terminology. But if we were to look through the history of science, we would find that such controversy has been a part of the struggle to understand many phenomena and notions in all of scholarship. That is, the evolution of thinking on relevance is no different than the evolution of thinking on so many other notions throughout the history of science.

A "paradigm" of the evolution of thinking on a notion in science can be made: *recognition of a problem*—first simple definitions and statements; *challenge*—refinement and broadening; *restatement*—hypotheses, theories, observations and experiments; *synthesis; restatement; challenge* and so on until the thinking temporarily reaches a satisfactory consensus and resolution (fully understanding that eventually it will be supplanted), a dead end or abandonment. By 1975, the thinking on relevance in information science has reached one of the *challenge* stages (about the third). But, before examining how information science became involved with relevance, let us consider the interpretation of the notion of relevance in other subjects as a broader context that should be taken into account by information scientists and librarians concerned with relevance.

LOGIC

Information science is not the only subject concerned with the notion of relevance. For two thousand years, logicians and philosophers have been struggling with the notion. They have developed extensive theories and interpretations. In logic, the notion of relevance has been involved in specifying and explaining various relationships, especially those of deduction, implication, entailment and logical consequence and to a lesser extent, in induction and concept formation. Relevance is used to state that a necessary condition for the validity of an inference from A to B is that A be relevant to B. In modern times, Carnap [(4) and in other works] among others, has extensively discussed relevance and irrele-

vance, here in regard to probabilities and confirmation of conclusions from premises. Anderson and Belnap (5) have vividly pointed out the fallacies of relevance and have provided, within the structure for a pure calculus of entailment, an "axiomatic system that captures the notion of relevance": relevance exhibits the properties of identity, transitivity, permutation and self-distribution.

PHILOSOPHY

Philosophers have involved, in a general way, the notion of relevance in the explanations of "aboutness" and in the theory of meaning. And, in a very specific way, relevance has been involved in explication of relations between different realities. In modern times the most powerful philosophical discussion of relevance was provided by Schutz (3) in his posthumously published notes. Schutz was concerned with making it possible to understand "what makes the social world tick," that is what makes it at once social and world. He contended that the social world ("lifeworld") is not simply one homogeneous affair, rather it is articulated or stratified into different realities, with relevance being the principle at the root of the stratification of the "lifeworld." Schutz elucidated three basic interdependent systems of relevances: *topical relevances, motivational relevances* and *interpretational relevances.* The circular interrelationship between the three systems has been graphically represented as shown in Fig. 1.
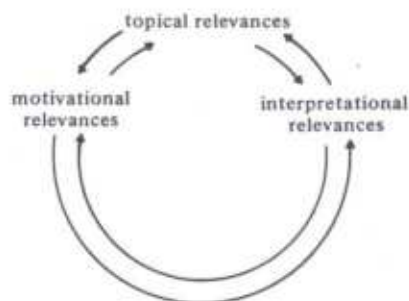

Fig. 1.

First are the topical relevances which involve perception of something being problematic "in the midst of the unstructuralized field of unproblematic familiarity." Interpretive relevances involve the stock of knowledge at hand in grasping the meaning of that which is perceived. Motivational relevances refer to the course of action to be adopted. The goals of such action motivates in turn the process of obtaining additional interpretative material; the perception may also be affected in this dynamic interaction.

INTERACTION

The thinking in logic has provided some information scientists [e.g., Hillman (6), Cooper (7)] with a necessary framework for their theoretical work on relevance. However, the thinking in philosophy, unfortunately, has not been directly recognized by any information scientists to date, although such works as that by Schutz, may have provided a direct framework for some of the views on relevance in information science [e.g., Foskett (8), Wilson (9), Kemp (10) and others]. Generally, some arguments that were already argued out may have been avoided. ·

Some other subjects have dealt with relevance, but none as directly and extensively as logic and philosophy. These subjects are sociology, in the sociology of knowledge; psychology, in the studies of perception, learning, and capacity of memory; and linguistics, in the studies of semantics and pragmatics. It has remained for information science to struggle with relevance in relation to communication and to emerge as the third subject that directly contributed to the thinking on that so elusive and so human a notion.

● How Information Science Became Involved with Relevance.

Relevance was the key notion in the emergence of information science and it has remained the basic notion in most of its theories and all of its practice. Thus, a review of relevance has to begin with a review of information science.

A field of activity and a subject of study are defined, fundamentally, by the problems attacked and operationally by the solutions offered and methods used, that is, by the work done. As problems and/or solutions change over time, specific definitions of a field or subject change as well.

Information science is a field and a subject that is concerned with problems arising in communication of knowledge in general and with records in such communication in particular, from both applied and basic points of view. It shares this concern with other fields, notably those of librarianship and of documentation; thus, this sharing of concerns specifies the fundamental relationship between information science and librarianship. It follows that the thinking on relevance in information science should be of direct interest to librarianship and vice versa.

We may further define information science by enumerating the areas of applied (i.e., professional or practical) and of basic (scientific) concerns and work. Of major interest to practical applications of information science have been: 1) technical aspects of the communication of knowledge, which involve a variety of applications of information technology for information processing and transmission; 2) representational aspects, which involve the development of a variety of languages, vocabularies and classifications for representing information, various types of file organization and procedures and logic for retrieval; 3) systems aspects which involve the design, development and operations of a variety of information systems in general and information retrieval (IR) systems in particular, and also involve the development of complex information networks and of an information industry.

On the theoretical side, information science studies have dealt with the behavior and effects of information as a phenomenon and communication as a process; information users and uses; the processes in and evaluation of information systems; and finally, the various aspects of the ecological environment of information systems, such as the structure of scientific and other literatures and the structure and relations in scientific and other social communications. Quantitative studies involving characteristics and empirical laws in communication have created study areas of their own under the names of bibliometrics and scientometrics (a more appropriate universal term may be "informetrics, in line with sociometics, econometics, psychometrics, etc.). Studies in the ecology of communication have carved out for information science a scientific problem area, which is contributing to the coagulation of information science as a scientific subject.

But why has all this happened? Why has information science emerged on its own and not as part of librarianship or documentation, which would be most logical? It has to do with relevance.

Why, then, has relevance emerged as a central notion of information science? It has to do with interpretation of the problems in scientific communication.

SCIENTIFIC COMMUNICATION

Although it proliferated into other areas, information science has its roots in the problem encountered in scientific communication. So has documentation, one of its predecessors. To achieve an understanding of relevance and indeed of information science, as well as some understanding of relations between information science and documentation and between information science and librarianship, one has to achieve some understanding of the nature of scientific communication.

Modern science has developed a particular mechanism of communication which began with the appearance of the first scientific journals in the 17th Century and has remained the same to this date. This mechanism is based on the following: the systematic and selective publication of fragments of work—items of knowledge related to a broader problem rather than complete treatises; the selective derivation from and selective integration into a network of other works; and an evaluation before and after publication. All of this is ultimately aimed toward the creation of what Ziman (11) calls "public knowledge," that is "the aim of scientists is to create, criticize and contribute to a rational consensus of ideas and information."

It is this selective concern with fragments of knowledge that is enabling effective functioning of science and that has led to concern with relevance. That is, to be effective, scientific communication, and indeed science itself, has to deal not with any old kind of information but with relevant information. And the history of science is the history of that effectiveness.

Ziman (12), Price (13) and others have pointed out that the invention of the mechanism for the systematic publication of fragments of scientific work may well have been the key event in the history of modern science. This invention has enabled science to grow so much faster than the rest of scholarship.

There are many other aspects that play a role in scientific communication (e.g., invisible colleges, conferences, professional societies, the system of recognition and challenge, and the whole governance of science). However, all follow from and end up in this particular selective mechanism.

BALANCING COMMUNICATION ECOLOGY

Over these last three centuries, communication in science has developed into an ecological system with elaborately organized and interdependent subsystems or strata [Warren and Goffman (14)]. Periodically, there have been upsets in that ecology caused by various factors. In this century such upsets have been caused by a combination of effects due to: 1) the large quantitative increases in the number of scientists and subsequently in the number of publications; 2) the qualitative difficulties in selection; 3) the breakdown of boundaries between subjects and 4) the increases in specializations. As a consequence of the ecological imbalances and the resultant problems in scientific communication, fields of activity have emerged that are directly and primarily concerned with a study of and a *fix* for these upsets.

At the turn of this century documentation emerged, which defined the problem at that time as one of the organization of knowledge; thus, it developed a concern with classification, indexing, etc. Indexing and abstracting services emerged as a *fix*. After the second World War information science emerged, which defined the problem at that time as one of providing the scientist with information; thus it developed a *concern with relevance* for it was perceived that the *amounts* of nonrelevance endanger communication. Information retrieval systems emerged applying a *technological fix* to the problem.

Shera and Egan (15) thought that the emergence of documentation was due to the "failure of librarianship" to address itself to the problem of scientific communication. In turn, one may think that the emergence of information science is due to the failure of documentation to address itself to the problems of the output of scientific communication. However, fields do not really develop because of the failure of other fields, but because they carve out a problem area for themselves and because

they build a rational consensus of ideas and information about the problem that leads to solution. The success or failure lies in the adequacy of defining and then addressing the problem. The success of information science, whatever there is, is due to the fact that it did address itself to relevance, and the failure, whatever it may be, will be because it did not address relevance adequately.

INFORMATION AND RELEVANT INFORMATION

As far as I can determine, S.C. Bradford was the first one to use the term *relevant* in the context that it is used today in information science. In the 1930's and 40's, he talked about articles "relevant to a subject." In the 40's and 50's, development of information retrieval (IR) systems began. From the onset, the main objective of IR systems was a provision of relevant information to users. A worldwide consensus emerged on that.

The distinction between *information* and *relevant information* was made in recognition of the selective mechanism of scientific communication and in order to underline the user orientation of IR systems. However, that distinction, although intuitively quite clear, became and has remained a major point of discord due to a lack of a consensus on meaning. From the outset it was recognized that relevance indicates a relation. But what relations does it involve? Between what elements? What factors affect the relation? The thinking on relevance in information science evolved around these questions and so has the controversy. To understand the thinking and possibly unravel the controversy, we first have to build a framework within which this could be achieved, a framework within which the thinking on relevance can be advanced.

● **How to Construct a Framework for Viewing Relevance from Intuitive Understanding and Then on to More Elaborate Communication Models.**

INTUITIVE UNDERSTANDING

Intuitively, we understand quite well what relevance means. It is a primitive "y' know" concept, as is information for which we hardly need a definition. When in communication with no particular outcome in mind (small talk, for instance), relevance plays little or no role. However, if and when any productive contact is desired, consciously or not, we involve and use this intuitive notion of relevance. This affects the whole process of communication, overtly or subtly. Thus, our intuitive understanding of relevance has something to do with productive, effective communication—how well the process was conducted, how good were the results. Relevance is, then, a fundamental aspect of human communication.

We also understand intuitively that this effectiveness, this productivity, depends on a great many factors which

could involve different criteria. And like so many other things in life, relevance is relative. Some things are more relevant than others, some things are not relevant any more, and some have a chance of becoming relevant. Relevance depends a great deal on what we already know and on what is generally known. We must admit that there are various aspects that at times predominate in determining relevance, such as: what we think we want and how we ask for it; how we understand what is asked and what we think is really asked; what is wanted in contrast to what is really needed; who is asked, who is asking; what the situation is; what will be done with what is provided; and so on. In other words, we know that we can look at relevance from different points of view. And that is the problem.

COMMUNICATION

To create a framework for reviewing and relating the different views of relevance in information science, first we have to consider the process of communication. Communication is a process where something called information is transmitted from one object to another [Goffman (16), via Shannon-Weaver (17), via Aristotle]. The first object can be called the source; the second, the destination. A dynamic, interactive feedback can occur between a source and a destination; they can exchange roles [Wiener (18)]. Communication can be considered as a process on its own, as Shannon did in information theory, or as a process effecting other processes, as Wiener did in founding Cybernetics. That is, the role of environment can be considered. We may not know what information is as a phenomenon, any more than we know what energy, matter, gravity or electricity is; but we can study its behavior and effects. As Shannon and Weaver pointed out, three levels of problems can occur in communication: 1) technical, 2) semantic, and 3) behavioral. Semantic problems obviously also involve the technical and behavioral problems involve the other two.

In this context of communication and communication problems, we can consider *relevance as a measure* of the effectiveness of a contact between a source and a destination in a communication process*. And, since a measure is a relation, relevance is also a relation.

COMMUNICATION OF KNOWLEDGE

Communication is used in many diverse contexts; *e.g.*, media, signal transmission, speech and hearing, rhetoric, propaganda, advertising, medicine, psychoanalysis, etc.

Thus, communication has related but different connotations. *Information* is used in Roget in at least seven diverse senses; and, when considering synonyms, there are over 100 associated words. In Shannon's information theory, information is restricted to the context of signals; information is very specifically defined as a property of a collection of coded signals or messages which reduce the receiver's uncertainty about which message is sent. Information theory treats only the technical problems of communication.

In information science, the connotation of *communication* and *information* is extended to, and limited to, the context of *knowledge* as used in the theory of knowledge. Information science attempts to treat all three levels of communication problems. For information science to keep this context and connotation in mind, we use the term *communication of knowledge*, although strictly speaking it is not knowledge but data, information or information conveying objects that are being transmitted.[†] In simple terms, the distinction is as between "to know" and "to inform."

We may think of public knowledge as being organized into a structure of subjects, represented in a language and recorded into a literature, elements of which can be called documents. Broadly speaking then, subject knowledge is represented by subject literature; thus, documents may convey information. The structures of subject knowledge and of subject literature, although related, are not the same. And the structure of linguistics or other symbolic representations is still different.

Both a source and a destination involved in the communication of knowledge have, as one of the elements, a file (or files) where subject knowledge and/or its representations are stored in an organized manner. (Examples of files are memory, library collection, catalog, computer file, data bank, store of sentences, and the like.) *Communication of knowledge is effective when and if information that is transmitted from one file results in changes in another. Relevance is the measure of these changes.*

Changes consist of additions to, deletions from, or reorganization of the files of knowledge and/or the files of representations. One can take a much broader view and argue that communication of knowledge is effective when and if it has directly observable results, such as changes in actions or behavior. The argument is grossly

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deficient in that such results are effected by a great many other factors, in addition to and unrelated to, the communication of knowledge.

In any case, since so many elements are involved in the communication of knowledge and in its effectiveness, relevance can be considered from different points of view (*e.g.*, involving elements of subject knowledge, of subject literature, of any representation of the source's file, of the destination's file, or of the processes). One can consider them separately or together in various combinations or in various hierarchies. And there are still other aspects to consider.

INFORMATION SYSTEMS

Imbedded in the communication of knowledge may be information systems which are aimed at enabling, enhancing, preserving or extending the process. And associated with such systems are sources and files. An information system selects from existing subject knowledge, subject literature and/or any of its representations, organizes the selections in some manner in its files, and disseminates the selections in some manner to given destinations. Other communication systems, such as signal transmission systems, graphic reproduction systems and computing systems, can be associated with information systems.

A variety of information systems has been built for a variety of types of communication of knowledge, uses, conditions and environments; desires for effectiveness or efficiency; and understandings of what the information problems are. Underlying all of them, one can find explicitly stated or implicitly assumed some interpretation of the notion of relevance. Therefore, when considering relevance, one may also have to involve aspects of information systems. And there are still other aspects to consider.

ENVIRONMENT; VALUES

Communication of knowledge and information systems can be considered by themselves, but they do not exist in a vacuum. They operate within, by means of, and under constraints imposed by their environment. They affect and are affected by the environment. The same knowledge communication process, the same information system, can be related to a number of realities of an environment, to a number of environments and can perform many functions.

Knowledge, information, communication, information systems—all are imbedded in, all reflect some system of human values—ethical, social, philosophical, political, religious and/or legal values. Therefore, when considering relevance, one may also involve aspects of the environments, realities and values.

SUMMARY

Given that, in the context of information science, relevance is considered as a measure of the effectiveness

of the contact between a source and a destination in a communication process (with all the other considerations described) —then, in considering what factors and relations are involved in relevance, we can consider the various elements or aspects of the:

1. Subject knowledge,
2. Subject literature,
3. Any other linguistic or symbolic representation,
4. Source, especially the file or files,
5. Destination, especially the file or files,
6. Information systems,
7. Environments, realities, functions and
8. Values.

The majority of works on relevance in information science have concentrated on determining:

1. What factors or elements enter into the notion of relevance?
2. What relation does the notion of relevance specify?

The controversy stems either from insistence that *only* some of the enumerated factors or relations are *the* factors or relations, or from the failure to recognize the existence of some other factors. The confusion stems from a very low adherence to the basics of semantic hygiene.

I wish to suggest that all the works, views and ensuing conflicts on relevance that have emerged so far in information science can be interpreted within the above framework. Moreover, I suggest that when and if a complete theory of relevance emerges in the context of information science, it will have to emerge within this framework and incorporate at least the enumerated aspects.

● **How the *System's View* of Relevance Developed and How *IT* Has Been Challenged.**

LOGIC OF RETRIEVAL

The Second World War spurred unprecedented scientific and technological activity resulting in a mass of reports and literature. The end of the War brought suggestions (as by Vannevar Bush) to apply the emerging computer technology to control records of science and technology. As a result, information retrieval (IR) systems emerged in the late 40's and early 50's, developed by such pioneers as Taube, Perry, Mooers and Luhn. Principles of information retrieval that were laid down then have remained to this day.

It has been accepted explicitly or implicitly that the main objective of an IR system is to retrieve information relevant to user queries. The logic of search and retrieval is based on the algebra of sets, Boolean algebra, which is well formulated and thus easily applicable to computer manipulations. Inherent in the application of this logic is the fundamental assumption: those docu-

great testing debate of information science ensued with periodic ripples to this date. The debate did not concentrate at all on the results but on the methods, and the central issue was a measuring methodology. How was the relevance of the answers determined? How should it be determined? Who are to be the relevance judges? How is the relevance judgment to be passed?

The debate imperceptibly, but completely, shifted the problem of relevance from the source to the *destination*. At issue was relevance judgment. The thinking that the notion of relevance is most connected to user judgment, or the *destination's view* of relevance, was born.

● How the *Destination's View* Emerged Equating Relevance with Relevance Judgment and How Experimentation Was Spurred.

The great testing debate in the early and mid-60's in large part turned into a relevance debate. As a result, relevance definitions proliferated by the dozen and a few hypotheses emerged. Eventually, two schools of thought developed.

One school has suggested that relevance is such an elusive and subjective property that it cannot serve as a criterion for performance testing [*e.g.*, Doyle (*26*)]. The other school took the view that experimentation with relevance judgments should precede adoption or non-adoption of relevance as performance criterion [*e.g.*, Cuadra (*27*)]. Thus, psychology entered information science largely as a result of concern with relevance, or rather with relevance judgments.

In 1964, the National Science Foundation called an invitational conference of leaders in the field to assess the results of IR testing and to chart new paths. One of the conclusions stated that the "major obstacle to progress in evaluation of IR systems is the lack of sufficient knowledge regarding. . .human assessments of the relevance of retrieved documents" (*28*). This spurred experimentation with relevance judgments, which in turn solidified the *destination's view* of relevance. Experiments were clearly affected by the definitions and hypotheses that emerged.

DEFINITIONS

Numerous definitions of relevance were offered in the 60's, mainly as a result of the criticism that it is not clear what the term means. There was a rather naive belief that a *good* definition by itself would make it clear and that the controversy would then go away. A *good* definition, in this context, referred to a paraphrase. By themselves, paraphrases, of course, do no such thing. However, relevance definitions were a form of hypotheses enumerating factors that entered into the relations. Thus, the definitions played an important role in setting the boundaries of experiments. Definitions fell into a general pattern:

Relevance is the *A* of a *B* existing between a *C* and a *D* as determined by an *E*.

In various definitions the slots were filled with fillers such as these:

A	B	C
measure degree dimension estimate appraisal relation	corresondence utility connection satisfaction fit bearing matching	document article textual form reference information provided fact

D	E
query request information used point of view information requirement statement	person judge user requester information specialist

As an aid to their experiments, Cuadra and Katter (*29*) established this definition:

> Relevance is the correspondence in context between an information requirement statement and an article; *i.e.*, the extent to which the article covers material that is appropriate to the requirement statement.

The most obvious criticism of these, as all other paraphrasing type definitions, is that they do not first establish primitive terms and then proceed to more complex definitions, using proofs or evidence where necessary; but they simply substitute terms that are as undefined as the term which they tried to define was at the outset. The most obvious advantage of paraphrasing definitions is that such definitions provide a preliminary context for further work.

HYPOTHESES

The hypotheses offered in relation to experimentation with relevance judgments by and large concentrated on enumerating and classifying the factors that affect relevance judgments. For instance, Rees and Saracevic (*30*) hypothesized on the variables and conditions under which the judgment would achieve a high degree of agreement. O'Connor (*31*) concentrated on the reasons for relevance judgments disagreements, on conditions under which agreement may or may not coincide, and related these conditions to unclearness. Cuadra and Katter (*29*) provided the handiest classification scheme and the largest enumeration of factors affecting relevance judg-

ments (answers, facts, data) retrieved are also those relevant to the query; those not retrieved are not relevant. In some systems documents can be ordered (evaluated, associated) as to their relevance and retrieved when some specified threshold is reached, and even presented in some ordered form; but, even here, the assumption that retrieved/not retrieved corresponds to *relevant/not relevant* still holds.

FALSE DROPS

The early pioneers quite correctly recognized that not all that will be retrieved will be relevant [Mooers (*20*), Perry (*21*) and Taube (*22*)]. Their concern was with non-relevance, with unwanted retrieval, rather than relevance. They diagnosed that the *false drops, noise, false coordinations* and *extra tallies* are due to internal malpractices—the ineffectiveness of whatever document representation was used and/or the inadequacy in the way these were applied. Thus, the *system's view* of relevance was a result of the thinking that relevance is mostly affected by the internal aspects and manipulations of the system. Relevance was conceived in terms of indexing, coding, classification, linguistic manipulations, file organization, and eventually question analysis and searching strategies. This thinking led to development of a myriad of schemes, and to attention to input processing and manipulation almost to the exclusion of other aspects. In theoretical works, linguistics has been the subject of a great deal of attention because it is believed that it will lead to better representation schemes.

COMPLETENESS OF VIEW

Clearly, internal aspects of any system affect its performance. How a source manipulates information certainly influences the effectiveness of the contact with a destination, but it is not the exclusive aspect that enters into considerations of relevance. Therefore, the system's view of relevance, although correct, is incomplete. However, the most glaring incompleteness of that view does not lie in the fact that it does not recognize other aspects, but in the fact that it does not recognize selection into the system per se as one of the system's aspects that enters into relevance. As a result, to this date, selection into IR systems remains an aspect to which little attention is paid—articles on the topic of selection are scarce, investigations are few.

However, there has been another school of thinking, though it has not gained wide acceptance, in which selection into the system is the most important aspect that enters into relevance (exposed mostly by information scientists from Battelle Memorial Institute). Information analysis centers have developed as a result of this view. Since this view has not received a broader support of the people in the field, relatively few information analysis centers are in existence.

FIRST CHALLENGE

The challenge to the simplicity of the *system's view* began with the 1958 International Conference for Scientific Information (*23*). Later more substantiated challenges were offered in serious attempts to construct a theoretical framework for relevance [Hillman (6) and Goffman (*24*)]. Among others, these suggestions were offered:

1. The notion of relevance should be considered independently and prior to any particular method of representation or IR system;
2. There is a relevance to a subject;
3. Relevance is multivalued, a matter of degree, and not a simple yes/no decision;
4. Relevance of given documents may change as a result of other documents, as stock of knowledge at hand changes.

As powerful as these arguments were; they really did not succeed in widely spreading a different view of relevance. It remained for the great debate that followed the first attempts to test and evaluate IR systems to swing the pendulum to an opposite view.

TEST AND EVALUATION

Pioneers of IR development were, by and large, engineers and scientists. It was logical for them to think of testing a system or a method as soon as it was conceived. The first quantitative measuring units proposed were the familiar recall and precision* by Kent, Perry and associates (*25*). Although often challenged as to their adequacy, these or similar measuring units have remained in use to this day, and their use has spread worldwide. (There is a whole literature and many theoretical works on measuring units for IR systems, but they are not of direct interest to considerations of the notion of relevance.) Underlying these measuring units is relevance as a measure, as a criterion that reflects the performance of IR systems. Relevance was selected as a result of the recognition that the prime objective of IR systems is to provide relevant information to user queries.

The testing of IR systems began in the 1950's as unverified claims and counterclaims mounted and as investments rose. During the late 50's and early 60's, large scale tests conducted by C. Cleverdon at Cranfield and later tests by others caught universal attention. The number of papers reporting results was small, but the number of papers discussing the tests was very large. The

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Recall is the ratio of relevant answers retrieved over the total number of relevant answers in the file. *Precision* is the ratio of relevant answers retrieved over the total number of answers retrieved. Precision was originally called relevance, but the name was changed because of complaints of semantic confusion.

ment. They suggested the following general classes of variables that affect relevance judgment:

1. Documents and document representation,
2. Queries (or as they said: "Information Requirement Statements"),
3. Judgmental situations and conditions,
4. Modes of expression, and
5. People (judges).

All the hypotheses have given no direct consideration to the *system's view* of relevance. However, by acknowledging that documents and document representations are some of the factors affecting relevance judgment, a relation between the *system's view* and the *destination's view* of relevance is established.

The most obvious criticism of all the offered hypotheses is that they are not like rigid scientific hypotheses that can be directly tested under controlled conditions. They are axiomatic in nature, somewhat extending previous definitions and classifications. Still they have been a step in the right direction for they have led toward experimentally observed evidence and away from anecdotal types of evidence.

EXPERIMENTS

The first experimental observation related to relevance was reported in 1961. Until 1970, about two dozen experiments were reported. No experiments directly dealing with relevance were reported after 1970, as far as I can determine. Synthesis of the experiments is presented in the *Appendix*. The relatively small number of experiments, and the evident moratorium on relevance experimentation after 1970, may look strange, but it should be put in the context of the activities in the field of information science. The field is highly pragmatic; funds are expended mostly for practical and technological achievements; research funding is not as forthcoming in the 70's as it was in the 60's; and research interests have shifted.

All of the experiments could be criticized easily for methodological deficiencies, with some praised for their achievements. [For a lengthy review see Saracevic (*32*).] However, the experiments do offer important clues as to the nature of some of the factors that affect human revelance judgments. For some factors the experimental results provide ballpark estimates of the comparative extent to which they affect relevance judgments. For practitioners and researchers, these experimental findings could be of interest by themselves.

COMPLETENESS OF VIEW

The *destination's view* of relevance has concentrated on factors that affect human relevance judgment. It has equated relevance with relevance judgment. Certainly these factors affect relevance, but they are still only one of the aspects that influences the measure of the effec-

tiveness of the contact between a source and a destination in a communication process. The destination's view is not incorrect at all. As is the *system's view*, it is merely incomplete.

As mentioned, there were a few hypotheses suggested and a few experiments carried out. But we cannot assume that the hypotheses and experiments dealt with all, or even most, of the factors related to human relevance judgments. To the contrary, they just scratched the surface; the area is in dire need of further hypotheses and experiments.

One of the most obvious aspects not investigated is the effect of the limitations of human memory on relevance judgments. Miller (*33*) and others discussed "the magical number seven" as describing limits of human information processing. As the effect of selection from the subject has not been investigated from the *system's view*, the effect of another type of selection has also not been investigated from the *destination's view*, namely the selection due to the limitation of human memory in information processing. Such limitation is fully recognized in the practice of providing information. The effectiveness of communication and this process of selection are closely related. This has not been investigated, and it would be a most promising and important area of study.

- **How Bibliometrics Evolved and How It Is Related to the** *Subject Literature View* **of Relevance.**

Up to the 1970's, most of the works directly concerned with relevance in information science have concentrated either on *system's* or on *destination's* view of relevance. However, chronologically speaking, both of these views were preceded by the *subject literature view* of relevance. As mentioned, S.C. Bradford was concerned in the 1930's and 40's with articles "relevant to a subject." His work pioneered the area that later became known as bibliometrics, the "quantitative treatment of the properties of recorded discourse and behavior appertaining to it" [Fairthorne (*34*)]. Although some bibliometric work was continued in the 40's and 50's, it wasn't until the 60's that work in bibliometrics started attracting more people and more attention; and it wasn't until the 70's that it started to blossom.

In bibliometrics a number of empirical laws have been uncovered, theories have been suggested and quantitative observations have been made. But the strength of the work in bibliometrics lies in the direct connection between empirical laws and theories on one hand, and observation on the other. (Unfortunately, by the way, this is not usual in most areas of work in information science or librarianship, including relevance.) Excellent reviews of bibliometric works have appeared, such as that by Fairthorne (*34*), who concentrated on showing relationship between various bibliometric and other hyperbolic distributions; by Brookes (*35*), who summarized

bibliometric applications of significance to information science and librarianship; by Line and Sandison (36), who synthesized approximately 180 studies that deal with obsolescence and changes in use of literature over time. Admittedly, bibliometric works have not been concerned with relevance, not directly; but even if not mentioned or realized, a concern with relevance is fundamental to most bibliometric works and also to bibliographic controls. Let me elaborate further on this point and suggest the nature of the *subject literature view* of relevance.

DISTRIBUTIONS: BRADFORD, LOTKA, ZIPF AND/OR MANDELBROT

Originally Bradford was interested in the rate that given sources, such as journals, contained items (articles) relevant to a given subject; he was interested in the pattern of a statistical distribution which will describe the relation between a quantity (journals) and a yield (articles). He observed that the scatter of articles on a subject across journals in which they appeared forms a regular pattern of diminishing returns, and he stated his law of literature scatter.*

For a century or so, a similar statistical relation between a quantity and a yield was observed in relation to many phenomena (e.g., Pareto distribution of income). Explanations and interpretations were given according to the interests of the subject and the nature of the phenomena. In other words, a similar statistical distribution described patterns of many phenomena without assuming proximity of causes. The distributions afford a method of description (conformity or non-conformity) and prediction. They do not describe the underlying causes and mechanisms. In information science, the family of these distributions was given the names of Bradford, Lotka, Zipf and/or Mandelbrot (see Fairthorne's review).

Lotka (38) investigated the productivity of authors in scientific subjects: he found that a large proportion of literature is produced by a small number of authors distributed so that the number of people producing n papers is approximately proportional to $1/n^2$. Zipf (39) investigated distribution of words in a text. The finding is similar: a small number of words appear very often and the frequency of use of words falls off in a regular pattern—if the words are ranked by frequency of appearance in a text, then rank times frequency is approximately constant. Price (40) investigated the pattern of citation networks and found that the number of papers cited at frequencies above average is small, forming a

"research front." Urquhart (41) investigated the patterns of use of periodicals from a large scientific library; the use was heavily oriented toward a small portion of the collection. Saracevic (42) studied the distribution of documents retrieved as answers from an experimental IR system; he found that the distribution follows Bradford's law—taking all queries together, a small number of documents were repeatedly retrieved as answers forming a nucleus, with the rest falling off in the expected Bradford pattern. Then the relevance judgments of users on the same retrieved answers was studied; many were judged not relevant, but the distribution of those documents that were judged relevant again conformed to Bradford's law. Numerous other studies could be cited on the same or similar aspects—studies related to the use of libraries and of literature, distribution of index terms in subject indexes, citation patterns, etc. The observed statistical distributions are similar.

SUBJECT LITERATURE VIEW OF RELEVANCE

Attempts were made to associate some of the facts studied in bibliometrics and the notion of relevance. In the Soviet Union, Kozachkov (43) related the notion of relevance to the "process of scientific cognition" and described various aspects of scientific literature as growth, scatter and obsolescence in terms of their relation to relevance. Saracevic (32, 42) synthesized a number of the distributions and findings in bibliometrics and interpreted them in terms of relevance calling them "relevance related distributions." The appearance of articles in journals, the contribution of authors to literature, the networks of citations, the changes in the use and the obsolescence of literature, the use of literature from libraries or IR systems, etc., are all manifestations of communications of knowledge. Sometimes it is not realized that these and similar manifestations are not independent of each other, even though they may be viewed one at a time. They are manifestations of a larger whole; namely, they relate to the structure of subject literatures. I wish to suggest that underlying all the above manifestations of communication of knowledge is the notion of relevance. These manifestations form the *subject literature view* of relevance.

So far, the investigations in information science have concentrated mostly on the statistical distribution patterns of these various manifestations. Obviously distribution patterns are but one aspect to be investigated; so much more remains to be learned even with regard to distributions. Still, what is emerging is a picture of the structure of subject literatures, of the patterns of what went on and what is going on. Needless to say, a rational forecast of what may be expected to be going on in the subject literatures, and with what probability, is dependent on the degree and the depth of familiarity with their structure. Here lies the great practical importance of works on the structure of subject literatures.

Of critical importance would be to investigate the mechanism that operates to form the given structure of

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*Bradford (37) formulated the law as follows:

". . .if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus, where the number of periodicals in the nucleus and succeeding zones will be as $1:n:n^2:n^3...$"

subject literatures over time. As suggested by many, the mechanism underlying the investigated distribution is one of selection, a "success-breeds-success" mechanism, a Darwinian mechanism. Previously I suggested that the notion of relevance underlies the described manifestations. In generalizing, I wish to suggest that notion of relevance underlies all of the *mechanisms* that form the structure of subject literatures. Therefore, the notion of relevance also underlies the *structure* of the subject literature itself. I suggest that the given mechanisms exist and the given structures are found because of the requirements of effective communications necessary for survival, procreation and use of the subject knowledge. Thus, an association between relevance and the structure of subject literature exists as well. We may better understand both the structure of subject literature and the notion of relevance if we explore their association.

COMPLETENESS OF THE VIEW

Effectiveness of communication depends on many factors. Various views on relevance result from considering the effectiveness at different points of the process. Thus emerged different classification of the factors with different priorities. None of the views is by itself incorrect, but taking only one view is incomplete. Along with the *system's* and the *destination's* view of relevance, we may add the *subject literature view* of relevance. This view can be built around considerations of the structure of subject literatures. The view has not been developed to any extent yet, but there is a start. It is premature to talk about the completeness of the view.

The importance of the *subject literature view* of relevance to other views and to the total knowledge communication process, especially where information systems are involved, is great. For information systems, the process starts with subject literatures. The aim of information systems is to enable and to enhance contact between subject literature and users—destinations. Therefore, subject literature affects all aspects. The *system's view* of relevance has to take into account that selection from the literature to the system influences effectiveness of the source. The *destination's view* of relevance has to take into account that answers can be provided only within the subject knowledge and subject literature. This provides for a relation between the three views.

● How Splitting of the Notion Began and the *Subject Knowledge View* of Relevance Resulted.

In the early 1960's, direct suggestions that relevance involved numerous relations and that a distinction should be made between various relations were forthcoming. Most often a distinction was made between relevance and pertinence, stemming originally from the distinction made between a question and an information need.

THE CONCEPT OF INFORMATION NEED

Experience has taught us that at times, often unintentionally, a question does not exactly coincide with what a questioner had on his/her mind, that it may be difficult to verbalize a question even if it is in one's mind, and that people may tend to answer what they think the questioner should have asked, rather than answer the question as formulated.

Operationally in IR systems and libraries, question analyses, reference interviews, and the like are aimed at clarifying the questions and reducing any differences between the question as asked and the question in one's mind. The questioner's stock of knowledge at hand and the intended use of answers are also often probed to help in the provision of the most related answer.

Out of these experiences and out of the sociological concepts of *need* and *need-event* came the concept of information need in information science. Information need is a psychological state associated with uncertainty, and with the desire to know an unknown. "It is not directly observable. . . but it has a definite existence in the mind of the user at least and so it is useful to have a term by which one may refer to it." [Cooper (7)]. But the concept of information need has had its fierce critics in information science, as the general concept of need has had in sociology: "Numerous explanations, all unclear. . . sacred expression. . .cover up for question negotiation. . ." [O'Connor (44)]. However, to this date the concept of information need remains chiefly to distinguish between a state of the mind and the subsequent representation in a question.

PERTINENCE

The concept of information need brought out the notion of pertinence. Numerous authors made this following or similar distinction [*e.g.*, Rees and Saracevic (45)]. The question-asking, question-answering process can be represented by the diagram in Fig. 2.
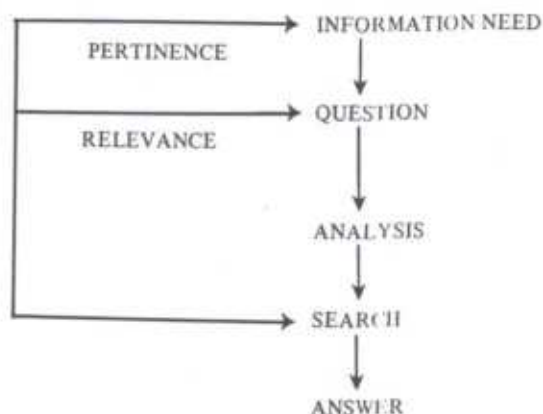

Fig. 2.

Relevance is the property which assigns certain members of a file (*e.g.*, documents) to the question; *pertinence* is the property which assigns them to the information need [Goffman and Newill (46)]. Subsequently, (as known from experience) some relevant answers are also pertinent; but there could be relevant answers that are not pertinent and pertinent answers that are not relevant. It has often been argued that, from the user's point of view, desirable answers are pertinent answers; but, in reality, an IR system can only provide relevant answers. That is, a system can only answer questions. It can only guess what the information need is. In practice, there is often a real tug of war in trying to satisfy information needs and not just answer questions.

FOSKETT'S PUBLIC KNOWLEDGE—PRIVATE KNOWLEDGE

Although information need is a satisfactory concept from a practical point of view, from a more theoretical point of view the whole concept of *need* in explaining states of mind, stocks of knowledge at hand, and ensuing changes is neither satisfactory nor comfortable. Given that a distinction between relevance and pertinence is to be made, many have felt that an explanation away from information need is required. Cooper (7) in defining logical relevance (discussed in a later section entitled, "How Theories of Relevance Have Covered Different Aspects and Why They Are Important") inspired a different explanation although he kept to the concept of an information need.

In a brief note, Foskett (8) suggested a different distinction between pertinence and relevance. Taking Ziman's "public knowledge" and augmenting it with Kuhn's paradigm on the pattern of thinking in a given field of science Foskett suggested that "relevance means being a part of a paradigm, or public knowledge, or consensus in a field; pertinence means related to the specific pattern of thought in a specific reader's mind."

KEMP'S PAIRS

Kemp (10) builds further from Foskett and discusses relevance and pertinence as related to public knowledge and private knowledge. He suggests that "relevance and pertinence each belong to a group of terms which have something in common—*public-ness* in one case and *private-ness* in the other," as shown in Table 1.

Table 1

Field	Public	Private
Information Science:	Relevance	Pertinence
Philosophy of Science:	Public Knowledge	Private Knowledge
Psychology:	Denotation	Connotation
Linguistics:	Semantics	Pragmatics
Sociology of Knowledge:	Formal Communication	Informal Communication

Furthermore, "relevance and pertinence are two different qualities, one capable of public objective assessment and the other being capable only of private subjective assessment." Pointing out similar distinctions from other fields, Kemp is providing an invitation to relate the knowledge on these other notions to the notion on relevance, an area certainly worth examining in great detail.

TWO *KNOWLEDGE VIEWS* OF RELEVANCE

Two *knowledge views* of relevance emerged from these delineations. In the suggested framework described previously in the section entitled "How to Construct a Framework for Viewing Relevance from Intuitive Understanding and Then on to More Elaborate Communication Models," we recognized that subject knowledge is at the outset of the knowledge communication process and that the destination (*e.g.*, a user) is at the end. We also recognized that the destination has a file—a mind in the case of a human being. There are a number of causes which can put the knowledge communication process into motion. One of them is the posing of a question by a destination. In this case there are two pairs of relations, two pairs of contact points that can be considered in determining what constitutes a measure of the effectiveness of the contact. The first pair of relations is between the *question* (or rather the subject content or topic of the question) and the existing *subject-knowledge*. This view corresponds, to some degree, to Schutz's "topical relevances" and to Kemp's concept of relevance as involving public knowledge. We may refer to it as *subject knowledge view of relevance*.

The second pair of relations is between *the file of the destination* (or rather the subject content of the file, the user's stock of knowledge at hand) and the existing *subject knowledge*. This view corresponds, to some degree, to Schutz's "interpretational relevances" and to Kemp's concept of pertinence as involving private knowledge. We may refer to it as the *destination's knowledge view of relevance*, or simply as the *pertinence view of relevance*.

Both of these views involve subject knowledge on one end of the relation, but they distinguish what is on the other.

SUBJECT KNOWLEDGE VIEW OF RELEVANCE AND ITS COMPLETENESS

The *subject knowledge view* of relevance stresses the nature, structure and extent of the subject knowledge on a topic given by a question. Subject knowledge and subject literature are obviously related, but they are not the same. Each has a structure that is related but is also quite different. Each is dynamic but on differing parameters. Subject knowledge involves knowledge per se, including redundancy, association, organization, and sedimentation. Subject literature as a representation involves authors, documents, producers, scatter, etc., as well as redundancy, associations and organization, which may

differ from those of knowledge. Basically, because of the redundancy of knowledge, we can have more than one set of answers to a question; because of the redundancy of literature, we can have more than one set of documents containing answers to a question. All this, and obviously much more including much that is not known on and about subject knowledge and subject literature, affects relevance. But one thing should be clear: relevance involving subject knowledge and relevance involving subject literature, although related, are not one and the same.

In the previous sections, it was established that every view of relevance, if considered by itself in isolation from other views, is incomplete by definition. Thus, let me consider only the completeness of further views within themselves.

In information science, there has been no work that has tried to directly relate the structure, properties and dynamics of subject knowledge to relevance. In philosophy this was attempted; *e.g.*, the work by Schutz. However, there have been numerous works in information science (and in other subjects) on or about subject knowledge that indirectly refer to and directly impinge upon relevance; *e.g.*, works by Price, Goffman, and Ziman. Conversely, relevance could be considered in the explanation of the mechanism underlying the various observations on the structure and dynamics of subject knowledge.

In discussing the completeness of the *destination's view* of relevance, it was suggested that the limits of human memory may play a significant role in explanations of relevance. Harmon (*47*) suggested the intriguing idea that the same limits of human memory affect the growth and formation of subjects and their break-up into specializations or related subjects. This may be a significant factor in explanations of the *subject knowledge view* of relevance.

The *subject knowledge view* has not been formed as yet in any detail, although considerable material from which it can be formed exists. I wish to suggest that the *subject knowledge view of relevance is fundamental to all other views of relevance*, because subject knowledge is fundamental to communication of knowledge. In that lies the importance and urgency of the work on that view.

PERTINENCE VIEW OF RELEVANCE AND ITS COMPLETENESS

The *destination's knowledge* or *pertinence view* of relevance stresses the content of the file of the destination. The interest in people as the ultimate destinations in knowledge communication is of overriding importance. Thus, in the *pertinence view* of relevance, determining factors are the nature, structure, and extent of one's stock of knowledge at hand, the process and sequence of its sedimentation, and the process of the mind's selectivity.

The *destination's view* of relevance (discussed previously in the section entitled "How the Destination's View Emerged Equating Relevance with Relevance Judgment and How Experimentation Was Spurred") attempts to incorporate all factors that enter into human relevance judgment. The stress is on judgment. One of these factors is the stock of knowledge at hand, which, in turn, is the base of the *pertinence view*. Therefore, the *destination's view* does incorporate the *pertinence view* of relevance, but the latter is much more to the point. The *pertinence view* has a firmer base than the broad *destination's view*, because of a considerable number of philosophical and psychological investigations that have been devoted to the understanding of how we know what we know. These could be directly related to the *pertinence view*. In comparison, there has been a much smaller number of investigations on human judgment; thus the broad *destination's view* has little to relate to.

No work on the *pertinence view* of relevance has gone beyond providing a general framework for the view, either in the concept of information need or in the contrast between public and private knowledge. There has been no enumeration of the specific elements and relations that are a part of either framework. Therefore, the view has only broad outlines—it is incomplete within these outlines. This incompletness provides an invitation for research.

● How the Disenchantment with Relevance Led to Another Splitting and How the *Pragmatic View* of Relevance Evolved.

RELEVANCE IS "NO GOOD"

Not surprisingly, there has been some disenchantment and impatience with the notion of relevance. A lot of declarative criticism has been leveled: "not appropriate," "inadequate," "too confusing," "ambiguous," "overused," "nonmeasurable," "doesn't reflect X" (X being a myriad of factors enumerated by critics that, indeed, relevance does not reflect), "not a good criterion," etc. Such criticisms have been especially pointed by those concerned with practice and/or with testing. How, indeed, does one run a system if one declares that it is aimed toward relevance, which is such an ambiguous notion? How, indeed, does one test systems using measures or criteria as slippery and imprecise as relevance? The criticisms do have a point; but, they lose validity when put in a human context.

Relevance is a human notion. How does one do anything neatly and precisely and unambiguously with human notions? Twentieth century science in moving toward a study of human notions found that reductionism to the "preciseness" of natural science does not work. The meaning of effectiveness in systems dealing with human notions is not the same as in engineering or business, and treating them in the same way leads to

social dissatisfaction. These aspects have not been taken into account by declarative critics of the use of the notion of relevance.

As a result of this disenchantment with the notion of relevance, substitutions have been suggested. *Usefulness, appropriateness, utility,* and other similar terms have been suggested and used as substitutions for relevance. Although the connotations of each of the substitutions is different, interestingly enough, the basic notion behind the use of the substitutions and of relevance is exactly the same. In these attempts the notion of relevance has not been abandoned, the word has been. As it was naïve to think that a *good definition* (i.e., a paraphrase) of relevance will resolve the problem, so it was equivalently naive to think that abandonment of the word will do it. However, although a mere substitution of words for notions does not resolve a problem, it can open new avenues of thinking.

CYBERNETICS; PRAGMATISM

In a number of fields, it has been realized that many of the processes can be looked at from the point of view of what happened to the results: what effect do processes have on other wholes and other processes? For instance, in cybernetics, Wiener looked at the governing effects of communication and, conversely, how the results of communication, through a feedback function, govern communication. He looked at how one process governs the other.

In logic and linguistics, the study of pragmatics emerged in addition to the traditional study of syntactics and semantics. Concern also developed over the interplay among the three. In the 19th century in philosophy, the school of thought called pragmatism developed, suggesting that the meaning of an idea consists of the pragmatic consequence of the idea. Radical pragmatism of the 20th century suggests that the activities of the consciousness, as actions in the outer world, have exclusively practical aims, in particular, aims designed to satisfy biological needs. In the fields of action—in manufacture, industry, production and governance—pragmatic concepts are quite prevalent.

It is not surprising then, that a *pragmatic view* of relevance has developed. However, it did not develop from cybernetics or the notion of pragmatics in logic, linguistics or philosophy, but rather strictly from the prevailing utilitarian, practical orientation of the fields of action. In addition, it developed from the demands and desire for justification in terms of cost-benefits that pervaded in the 60's and 70's, the social, behavioral and educational fields in general and information science in particular. The argument for the pragmatic view of relevance went as follows: it is fine for IR systems to provide relevant information, but the true role is to provide information that has utility—information that helps to directly resolve given problems, that directly bears on given actions, and/or that directly fits into given concerns and interests. Thus, it was argued that relevance is not a

proper measure for a true evaluation of IR systems. A true measure should be utilitarian in nature.

COOPER'S UTILITY

In defining *logical relevance* (see the next section), Cooper (7) made a distinction between relevance and utility: "... *relevance* has to do with *aboutness* (or *pertinence* or *topic-relatedness*) and is ultimately defined in terms of logical implication, whereas *utility* is a catch-all concept involving not only topic-relatedness but also quality, novelty, importance, credibility and many other things." Building on this distinction, Cooper (48) provided the first in-depth treatment of utility instead of relevance as a measure of retrieval effectiveness. He has built his argument on the assumption that "the purpose of retrieval systems is (or at least should be) to retrieve documents that are useful, not merely relevant." With further elaboration: "The success of a retrieval system must ultimately be judged on the basis of a comparison of some kind involving costs and benefits." Cooper uses the suggested measure of *utility*: "... in a complete neutral sense. It is simply a cover term for whatever the user finds to be of value about the system output, whatever its usefulness, its entertainment, or aesthetic value, or anything else."

Since this review has *not* concentrated on the measures and measuring units for testing of information retrieval systems, it is really of little or no interest here, or to any explication of relevance, if relevance, utility or whatever specific measure should be applied to test and evaluate any specific information retrieval system. However, Cooper's ideas on utility are a beginning of the explication of still another view of relevance that evolved— the *pragmatic view*—thus they are included here. Moreover, Cooper astutely notes a relation between his utility and relevance.

As in the *pertinence view*, in the *pragmatic view* the approach was to split the notion of relevance in order to differentiate and to argue that relevance is one thing, but X (pertinence, utility) is another, even though they are related. Imperceptibly, the thinking on relevance was moving during the last decade toward the concept that there are a number of *kinds* of relevances involving different relations. Different names started to be employed to characterize different kinds of relevance.

WILSON'S SITUATIONAL RELEVANCE

Another and slightly different explication of the *pragmatic view* of relevance was provided by Wilson (9). Wilson's explanation starts from the assumption that "relevance is not a single notion but many." He makes a basic distinction between psychological and logical relevance. The former deals with actual uses and actual effects of information. The latter is a double concept "of a relation between an item of information and a particular individual's personal view of the world and his situation in

it; and it is a concept in which relevance depends on logical bearing on some matter on which he has preferences."

To derive the notion of situational relevance, Wilson uses Cooper's definition of logical relevance derived from deductive logic and constructs a definition using probabilities of evidential relevance drawn from inductive logic. To specify the relations established by situational relevance, Wilson also uses the notions of an individual's: 1) concerns, 2) preferences over ranges of alternatives (similar to the use in economic theories), and 3) stock of knowledge. Situational relevance is defined as a relation between these three notions and an item of information, a relation which is established by inference either deductively (Cooper's logical relevance) or inductively (evidential relevance). "Situational relevance is relevance to a particular individual's situation—but to the situation as he sees it, not as others see it, nor as it *really* is." "Wilson suggests that situational relevance captures the "essentials of the vague popular notion of practical relevance. . .that must bear on our actions."

KOCHEN'S UTILITY FUNCTION

Kochen (*19*), in the first book ever that explicates rather than describes theoretical principles of information retrieval, made a distinction between "relevance as a relation between propositions and the recognition of relevance on its judgment by a user, which resembles a utility or significance judgment." This is the same distinction as Cooper's, but Kochen went further and formally defined the notion of utility.

Kochen adapted four well established axioms about preferences from utility theory to a strategy for searching document collections. Subsequently, he showed that, if a user is willing to abide by these axioms, then it is possible to provide for a given user with a given question a utility function that assigns a utility number to each document in the collection searched. [See Kochen (*19*) p. 138 for details.] Kochen recognizes that changes of preferences can take place over time, and thus, that the utility function can change as well. As with all utility functions, this one depends on the ability of users to assign preferences and associate probabilities, which is its fundamental weakness. In many ways one can argue that this expectation, although at times realistic, at other times certainly is not. Without preferences, there is no utility theory and subsequently no utility functions. But, bringing the notions of preferences and the whole armamentarium of the utility theory to considerations of relevance is an important contribution. It opens a new area of study which should be followed.

COMPLETENESS OF VIEW

Precise definition of logical relevance by Cooper inspired the development of the *pragmatic view* of relevance.

As with other views, the *pragmatic view* of relevance is incomplete, but less so. It does recognize some of the different aspects of relevance not recognized by other views. Explicitly, it allows for relevance to be measured at different points in the communication process. Significantly, there is a direct attempt (admittedly, barely a beginning attempt) to establish a relationship between different views of relevance. However, in the *pragmatic view* of relevance, immediate pragmatism of information in one form or another is the ultimate, definite, final criterion. What each individual does with information is superordinate to what the information is. A criticism of this view can be attempted from a platform of general criticism of pragmatism and cost-benefits.

Pragmatism has been a subject for serious criticism in philosophy. The chief criticism is that it applies to only one reality, that which is referred to as "paramount reality." It does not deal with the totality of human existence. And above all, it deals with that reality as if it were unquestionable.

In our times one of the operational reflections of pragmatism is the concept of cost-benefits, which is also subject to serious criticism. Clearly, the costs of a great many processes and actions can be, and must be, related to the accrued benefits. But, as many critics point out, a great many other processes and actions, especially those related to human notions, cannot and should not be judged on cost-benefit basis, especially not on that basis alone. Cost-benefits should not be an omni-criterion for all human actions and enterprises, whether or not they can be estimated. At any rate, in the case of knowledge, costs can be estimated; but true cost-benefits, hardly. Besides, decisions related to knowledge and knowledge systems are made primarily on ethical, political and sociological grounds, rather than on economic grounds.

There are limited situations where cost-benefits and relevance should be related. But, if the cost-benefits were to be universally applied to communication of knowledge, it would be the surest way to the destruction of its effectiveness. For instance: Would the Alexandrian library ever have been built if cost-benefit studies were a criterion for decision?

This should not be construed as a rejection of the *pragmatic view* of relevance. On the contrary, it is an important aspect to be explored, especially as to the factors involved in pragmatism of information and as to the relation to other views. What is rejected is the idea that pragmatism is the only, or even the basic, aspect to apply to relevance.

In the conclusion, let me relate three views centering around the destination. The *destination's view* concentrates on judgment, the *pertinence view* concentrates on the stock of knowledge at hand and the *pragmatic view* on immediate application or on the problem at hand. If the *pertinence view* is related to some degree to Schutz's "interpretational relevances," then the *pragmatic view* can be related to some degree to his "motivational rele-

vances." The *pertinence view* is fundamental to both other views, for the stock of knowledge at hand is fundamental to a judgment and to a problem. The *pertinence view* can be considered without involving the other two views; the *destination's view* has to involve the *pertinence view*, and it can but does not have to, involve the *pragmatic view*; the *pragmatic view* has to involve the other two.

• How Theories of Relevance Have Covered Different Aspects and Why They Are Important.

I left for last the discussion of the most significant work on relevance in information science: the attempts to formulate theories of relevance. As few and as sketchy as they are, the theoretical works have resulted in: 1) drawing methods and results from other and more rigorous subjects to the study of relevance, 2) illuminating the nature of the notion more and better than all the discussions combined, and 3) specifying the various relations involved which now enables classification of relations and a deeper study of specific relations. As with other theoretical work in information science, theoretical works on relevance have had only an indirect effect on practice.

MARON–KUHNS' RELEVANCE NUMBER

Maron and Kuhns (*49*) presented one of the first large, formal theoretical treatises in information science. They were concerned with the derivation of a probabilistic measure that would enable the ranking of documents as to their relevance. Considering that the "problem of explicating the notion of relevance (which is the basic concept in a theory of information retrieval) is similar to that of explicating the notion of amount of information (which is the basic concept of Shannon's communication theory), . . . we approach the notion of relevance also in a probabilistic sense." Their conditional probability, which specifies the "relevance number," involves the relation between a user's *request*, the *subject area* of the request, designation by a given *representation*, and a given *document* provided by a *system*. Regardless of any applications, the significance of Maron-Kuhns' explication lies in: 1) enumeration of the above factors in italic affecting relevance, 2) envisioning that there is a relation between these various factors, and 3) introduction of the concept of probabilities in describing the relations.

The probabilistic approach has been successful in many subjects in relation to many complex phenomena. There exists a systematic, formal body of knowledge related to probabilities and to the treatment of measures as probabilities. However, formulating a measure in terms of probabilities is one thing; approximating probabilities (deriving numerical values) is another. Often this is a major problem in experimentation and practice; but, without formulation first, there is no approximation at

all. Yet, even though Maron and Kuhns and many others have tried to approximate probabilities related to relevance, this experimental and practical problem remains unsatisfactorily resolved.

GOFFMAN'S RELEVANCE AS A MEASURE AND THE EPIDEMIC THEORY

In the mathematical theory of measures, four axioms describe the properties that a measure has to satisfy to be a measure: 1) it is real-valued and non-negative, 2) it is completely additive, 3) it has an order, and 4) it has an absolute zero. Goffman (*24*), used these properties to prove that, if relevance is determined solely on the basis of a query and each document in a file independently of other documents (the prevailing practice in IR systems), then relevance does not satisfy all of the axiomatic properties of a measure; *i.e.*, it is not completely additive. He also proved in another theorem that, if relevance is determined not only on the basis of query-document relation but also on the relations among documents, then relevance satisfies all the axiomatic properties of a measure. To be a measure, relevance also has to take into account association—the effects of the items of knowledge on each other. This, of course, supports efforts in associative indexing.

Goffman and Newill (*50*), elaborated on later by Goffman (*16*), developed an epidemic theory of communication equating the process of the spread of ideas to the spread of diseases. The notion of effective contact is central to the theory. A series of theorems proves the conditions under which the dynamics of the process changes over time in given populations. In the case of the information retrieval process (a sub-process in a communication process), relevance is considered the measure of the effectiveness of the contact. The information retrieval process is described as an interrogation procedure of a file of documents (objects which convey information). Assuming that a general measure of relevance is prababilistic, a series of mathematical definitions and theorems provides various conditions under which a set of documents exhibit various relations. Among others, Goffman proved mathematically that relevance is not associated with a unique subset of documents as answers from a file, and that more than one subset of answers is possible; that answers that were not initially relevant can become relevant in an appropriate sequence; and that relevance is an equivalence relation, which provides for a partitioning of a file in equivalence classes. It has been shown "that any measure of the effectiveness of information conveyed must depend upon what is already known. . . and (therefore, it is necessary to) introduce the notion of conditional probability of relevance."

The strength of the theory is that it provides for some of the dynamic aspects of communication and shows some of the complexity of relations of relevance as a measure using mathematical rigor. As a matter of fact, this is the only theory related to communication which has emerged in information science that attempts to

show some of the dynamics of the process. It clearly shows the large role that the *interplay* among documents has on relevance.

One of the more interesting things that should be done is to relate the dynamics of this communication theory, where effectiveness of the contact is a central notion, to the so-called *relevance-related* distributions (as in Bradford), which are essentially static in nature but involve relevance as well.

HILLMAN'S SIMILARITY CLASSES

Hillman (6) introduced logic to the treatment of relevance in information science. In treating the basic problem of defining relevance, Hillman suggested the use of the constructs in formal logic, particularly Carnap's concept-formation theory. Assuming that the problem of mutual relevances of queries and documents involves conceptual relatedness, Hillman critically examined various aspects in the theory of concept formation showing their applicability or non-applicability to the definition of relevance. He suggested that to describe relevance-relations in terms of similarity classes would be most appropriate. The theory is not complete, but its strength lies in the critical examination of a number of constructs in logic as to their applicability to the study of relevance and, even more so, in drawing the attention of information scientists to logic.

COOPER'S LOGICAL RELEVANCE

It remained for Cooper (7), to fully employ the armamentarium of deductive logic in a carefully argued out definition of what he called logical relevance. He addressed the nature of inference involved in relevance. He assumed that relevance is a relationship "holding between pieces of stored information on the one hand and user's information needs formulated as information needs representation on the other. . .both are linguistic entities of some kind." As in logic, Cooper takes a sentence to be the basic information-conveying unit of language. He also assumes that an information need and the data in an information retrieval system can be represented by declarative sentences. And, as a fundamental construct, he takes the relationship of "logic consequences" (*entailment*, or *logical implication*) from deductive logic, where a sentence (called *conclusion*) is a logical consequence of a set of sentences (called *premises*) when a set of conditions is fulfilled.

Given these restrictions:

1. A search query is a yes-no type question; thus, it can be transformed in a pair of yes-no *component statements* (*e.g.*, Is hydrogen a halogen element?).
2. The data stored in a system is in well formed sentences so that a *premise set* for the component statement can be derived by logical consequence. *A minimal premise set* is a set as small as possible—if a member is deleted the compo-

nent statement would no longer be a logical consequence of the premise set.
3. The retrieval is inferential; it deduces direct answers to input questions.

Then Cooper provides his "restricted definition":

"A stored sentence is *logically relevant* to (a representation of) an information need, if and only if it is a member of some minimal premise set of stored sentences for some component statements of that need."

In generalizing from that definition, Cooper shows that the *restricted definition* could also be applied to fact retrieval systems and even to document retrieval systems (but not precisely), taking the strategy of transforming whatever is stored into declarative sentences. The difficulties with this definition occur when dealing with induction (and inductive systems) rather than deduction, as fully acknowledged by Cooper; probabilities and degrees of relevance cannot be accommodated.

The strength of Cooper's approach is that it defines fully, and as precisely as deductive logic permits, one set of relations and one type of inference involved in relevance. As restricted as it is, Cooper's logical relevance has to be recognized as a first of its kind, inviting definitions of other possible types of inferences and providing grounds for differentiation. In his work on situational relevance, Wilson (9) (see the previous main section of this article), attempted briefly to incorporate inductive logic and probabilities into a definition of evidential relevance.

The *logical view* of relevance has concentrated on the *nature of relations* between elements, rather than on *enumeration of elements* that enter into relevance. The nature of these relations was treated as inferences. Two *logical views* emerged:

1. *Deductive inference view* drawing from deductive logic, and
2. *Probabilistic inference view* drawing from inductive logic and probabilities.

Since deductive logic is much more precise and complete than inductive logic, the first view is much more precise and complete than the second. The second view especially needs further elaboration.

COMPLETENESS OF THEORIES

None of the theories of relevance are complete in the sense that any of them incorporates all aspects of relevance. Each theory illuminates some aspect of relevance and provides a different method for describing the properties and relationships of the notion. No theory has, as yet, attempted to describe the mechanisms that account for the notion. In all probability, the forthcoming theories on relevance will be of a *step-by-step* nature, further illuminating some particular aspect of the notion.

Why so much stress on theories? The history of science provides numerous proofs that there is nothing

more practical then a good theory. It can easily be demonstrated how different conceptions, views and pseudo-theories of relevance have led to the development of given systems and of given practices and standards in many types of information systems. Complete and valid theoretical thinking on relevance has a potential of having great impact on the practice of information retrieval and librarianship in particular and on the communication of knowledge in general. Lack of theory most often leads to guessing games with little probability of positive impact.

● Back to the Framework

This review is an inventory and a classification. On one hand, I have attempted to trace the evolution of thinking on relevance, a key notion in information science; on the other hand, I have also attempted to provide a framework within which the widely dissonant ideas on relevance that have emerged could be interpreted and related to each other. If the classification, the framework, is valid, it does provide a potential for uncovering gaps in knowledge and indicating possible directions of future work.

Since the notion of relevance is part and parcel of knowledge, information and communication, it also involves the complexities, puzzles and controversies of the larger phenomena. Intuitively, the notion of relevance has to do with the success of the communication process. Therefore, we have taken the notion of relevance fundamentally to be a notion of the measure of the effectiveness of the contact between a source and a destination in a communication process.

In a slightly different context, Weiler (51) remarked that "the arguments about relevance are arguments about the framework of our discussion." And this is exactly what arguments about relevance in information science have been all about. What aspect of communication, what relations, should be considered in specifying relevance? What factors are to be considered in determining relevance?

Some more *formal* answers to these questions have been attempted in information science. Differences in answers have formed different views of relevance. As yet, none of the views has achieved a stage of a broad consensus; rather the thinking on the notion of relevance in information science seems to have reached a stage of perpetuating challenge.

The process of the communication of knowledge was suggested as a framework for considerations of relevance and as a source of a scheme for classifying various views of relevance that have emerged in information science. Even while measuring the same thing, a process can be validly measured at a number of different points in the sequence of events which involves different elements and relations—creating different viewpoints. This was exactly what has happened with relevance. Relevance can be and has been considered at a number of different points in

the process of communication of knowledge; thus different elements and relations were considered, and different viewpoints emerged. On a more specific level, relevance can be and has been considered in relation to specific types of knowledge communications.

Imbedded in the communication of knowledge are information systems which aim at enabling and enhancing the process. Different systems aim at enhancing different aspects of the process or are directed toward different uses or environments. Relevance can also be and has been considered with or without involving any of the information systems or their elements.

SUMMARY OF DIFFERENT VIEWS

Taking into account different elements and/or the nature of different relations in the communication of knowledge, the following views of relevance, arranged approximately by the sequence of events in the process, have emerged.

The *subject knowledge view of relevance* has considered the relation between the knowledge on or about the subject *and* a topic (question) on or about the subject.

The *subject literature view of relevance*, closely related to the *subject knowledge view*, has considered: the relations between the subject *and* its representation, the literature, or the relation between the literature *and* a topic (question) on the subject.

The *logical view of relevance* has been concerned with the *nature of the inference* between premises on a topic and conclusions from a subject or subject literature. Two views have emerged: 1) the *deductive inference view*, which has considered the relation between premises *and* conclusions on the basis of logical consequence; and 2) the *probabilistic inference view*, which has considered the relation among premises, information as evidence *and* conclusions on the the basis of degree of confirmation or probabilities.

The *system's view of relevance* has considered the contents of the file and/or the processes of a given information system *and* the relation to a subject or a subject literature, a topic (question), or a user or users.

The *destination's view of relevance* has considered the human judgment on the relation between documents conveying information *and* a topic (question).

The *pertinence or destination's knowledge view of relevance* has considered the relation between the stock of knowledge at hand of a knower *and* subject knowledge, or subject literature.

The *pragmatic view of relevance* has considered the relation between the immediate problem at hand of a user *and* the provided information, involving utility and preference as the base for interference.

The following can be ascertained: Different views of relevance are not independent of each other. It seems that there exists an interlocking, interplaying cycle of the various systems of relevances (*i.e.*, various systems of measures). Some systems may be considered as special

cases or subsystems of other more general systems. There is *no*, and there cannot be any *one specific*, view of relevance, for there does not exist any one system of relevance in communication. Different systems of relevances may involve some different factors, but they are coupled in such a way that they can hardly be considered without other systems of relevance. For instance, *pragmatic view* cannot be considered without involving the *pertinence view* or *destination's view* of relevance. None can be considered without *subject knowledge view*. Many practical problems in information systems and many cases of user dissatisfaction can now be explained as due to the existance of various systems of relevances.

Therefore, when considering relevance in a specific sense, one should be quite careful to indicate the elements and the nature of the relations between elements that are being considered. Different names can be given to the considerations of specific different sets of elements or different relations. This was started with names of *pertinence* and *logical relevance*. However, it should always be realized that any specific consideration of relevance is tied in with systems of relevances. A most significant advance in thinking on relevance will be achieved with the illumination of the interplay between these systems.

SPECULATION ON PROPERTIES AND FUTURE WORK

It has been explained that different views of relevance have arisen because in the communication of knowledge there are a number of dynamically interacting systems of relevances organized in some stratified or perhaps hierarchical fashion of complex systems. Each view has concentrated on one system. If this explanation is valid, then we may postulate that there should be some fundamental properties that are universal—common to all views or systems of relevance—and some unique properties that are specific to each system. At present we can only speculate that among the universal properties are:

> *Knowledge, knower*: all views assume a prior existence of a body of knowledge, or ideas or facts or their representations; or of a knower.

> *Selection*: implied by all views is a process of selection concentrating on elements or structure of above knowledge.

> *Inference*: selectivity is based on some form of inference.

> *Mapping*: the aim is some form of mapping of selected elements or structure of knowledge onto something—at a minimum onto some other elements or structure of knowledge.

> *Dynamics*: the dynamic interactions among properties are involved; changes in any property over time is possible.

> *Association*: the internal structure of elements of knowledge and other properties affect the dynamics and vice versa.

> *Redundancy*: more than one set of elements of knowledge, pattern of association or structure, form of inference, dynamics or mapping may satisfy the criteria of any and/or all properties.

If these, or some similar properties are indeed found to be universal to all views or systems of relevances, then an explication of each view will be incomplete if it does not in some way incorporate an explication of at least every one of the universal properties. Thinking on relevance can proceed in various directions, such as:

1. Taking a given view or system of relevance and proceeding to define fully all properties;
2. Taking a given property in one or a number of systems and defining and contrasting the nature of the property; for instance, this was started with the explications of the nature of inferences—deductive, inductive, probabilistic, preferential, etc.;
3. Taking a number of properties and explicating the interplay;
4. Taking a number of explicated systems of relevance and explicating the interplay between them. The ultimate thinking on relevance will be the one that explicates the interplay among all explicated systems of relevances.

In summarizing the framework for considering relevance, a number of elements or aspects have been enumerated. Information science has dealt with most of them, but not all. Most glaringly absent are considerations of environments and human values involved in communication of knowledge. Hopefully, future work on relevance will include these aspects as well.

Our understanding of relevance in communication is so much better, clearer, deeper, broader than it was when information science started after the Second World War. But, there is still a long, long way to go.

Appendix

Synthesis of the Experiments on
Relevance in Information Science

The experiments are organized and synthesized according to the five general classes of variables that affect human relevance judgment, as suggested by Cuadra and Katter (reviewed in the section entitled "How the *Destination's View* Emerged Equating Relevance with Relevance Judgment and How Experimentation was Spurred" under the paragraphs on "Hypotheses"). To derive conclusions, I examined the data and results of the experiments rather than use the conclu-

sions and claims of the authors. This synthesis is taken from Saracevic (52).

DOCUMENTS AND DOCUMENT REPRESENTATIONS

Documents and their representations were the first, and most frequently treated, variables in the study of relevance judgments. Documents evoked early interest since they are the items provided by IR systems to users, and thus observations concerning their effect upon the user and his judgment have direct practical implications for systems design and operations. The investigations covered:

1. The comparative effects on relevance judgments of titles, citations, abstracts and/or full texts (53, 54, 55, 56, 57);
2. The effects of stylistic characteristics of documents (29); and
3. The effects of degree of specificity and variations in document content in relation to queries (29, 54).

An analysis and correlation of experimental results suggest several conclusions:

1. It may be expected with a considerable degree of certainty that documents, or objects conveying information, are the major variables in relevance judgments.
2. Although a number of factors are aligned with documents as variables, the most important of these factors affecting relevance judgment appears to be the subject content of documents as compared to the subject content of the query. This finding relates to Schutz's "topical relevances."
3. Elements of style may also be expected to affect relevance judgments.
4. Highly specific subject content in a document appears to stimulate more relevance agreements.
5. Relevance judgments for the same article may be expected to differ from titles to full texts; titles should be utilized with considerable scepticism.
6. Relevance judgments for the same article may be expected to differ somewhat from abstracts to full texts, depending upon the abstract's type, length, detail, etc.

QUERIES

The query stimulates the generation of document as answers and documents are judged for relevance in relation to the query. Experimental observations were made on the query-document relationship:

1. The effects on relevance judgments of query specificity (29);
2. The effects on relevance judgments of judges' subject expertise at various stages of the research—the successive research stages were treated as enlargements of the queries (54);
3. The relation between the wording and phraseology of queries and documents judged relevant or non-relevant (58);
4. The relation between disagreements in relevance judgments and unclearness of query statements (59); and
5. The effect of judges' subject knowledge in relation to the subject content of queries (29, 54).

The following conclusions may be drawn:

1. The more judges know about a query, the higher is the agreement among judges on relevance judgments and the more stringent the judgments become.
2. The more judges discuss the inference from query to answer, the higher the agreement on relevance judgments.
3. A close similarity and correlation seems to exist between texts of queries and texts of relevant documents, which cannot be found between texts of queries and texts of non-relevant documents.
4. Document texts may be the most important factor in triggering relevance judgments in relation to stated queries; *i.e.*, if one finds a statement in a document resembling a query statement, one is assured of a high probability that the document will be considered relevant by the user stating the query.
5. The less one knows about a query, the greater the tendency to judge documents relevant. In specific terms, the less a system operator or user delegate knows about a query—its content, eventual use or the problem in relation to which the query is asked—the greater the temptation to judge documents relevant. These findings relate to Schutz's "innovational relevances."

JUDGMENTAL SITUATIONS AND CONDITIONS

This variable refers to the environment—real or constructed—within which relevance judgments are made. Two aspects are examined:

1. The effect of aspects and definitions of relevance upon relevance judgments (29, 54); and
2. The effect of time and stringency pressures on relevance judgments (29).

The results from these experiments are inconclusive and should be interpreted cautiously:

1. Not surprisingly, changes in experimental conditions may introduce changes in judgments;
2. Different definitions of relevance do not necessarily stimulate different relevance ratings; *i.e.*, people tend to treat relevance as a primitive notion; and
3. Greater pressure in the judgmental situations stimulates higher relevance ratings (*i.e.*, "more" relevant). This finding relates to Schutz's "motivational relevances."

MODES FOR EXPRESSION

This variable refers to the instruments (psychometric devices) by which judges express relevance judgments. Since instruments used for recording attitudes do affect the attitude, they become subjects of study. The experiments covered:

1. The comparative effects on relevance judgments of rating, ranking and ratio scales (29, 54, 60);
2. The effect of differing numbers of categories on rating scales (29);
3. The reliability of judgments as affected by different types of scales (54); and
4. The interaction of scale types with other variables tested (29, 54).

It may be concluded:

1. Different kinds of scales (rating, ranking and ratio scales) may produce slightly different judgments.
2. The more categories a rating scale has, the more comfortable the judges feel in their judgment; in any case, they may be more at ease with a scale having more than two and up to some ten categories.
3. It is not clear what type of scales are most reliable for use in recording relevance judgments. Some form of the ratio scale appears to have some advantage over other types of scales.
4. On the scales tested, judges with a high level of subject expertise tended to agree with themselves over a short period of time (e.g., a month).
5. It was found that the end points of scales were used most heavily regardless of the number of categories in the scale; i.e., documents tend to be rated very relevant or very non-relevant.
6. Relevance judgments of a group of judges on one document are not normally distributed but skewed in one direction.
7. It is most significant to note that the relative relevance score of documents in a group, especially among the documents with high relevance, may be expected to be remarkably consistent even when judges with differing backgrounds make the relevance judgments. Thus, it may be more profitable to compare the relative position of documents in a set than to compare the relevance ratings assigned to individual documents.

PEOPLE

The fundamental factor studies in all experiments reviewed was the consistency of, or agreement in, relevance judgments as affected by certain human characteristics. These characteristics usually dealt with the degree of subject or professional education. It should be noted that the human element as a variable is present to some extent in all previous conclusions presented. The following were investigated:

1. The ability of people to judge consistently the relevance of documents to their general interest (61);
2. The comparison of users' and non-users' (delegated) and experts' and non-experts' relevance judgments (62, 63);
3. The effect on relevance judgments of the documents intended use (29, 64);
4. The effect of academic and professional training on relevance judgments (29, 54); and
5. The relation between relevance judgments assigned by judges and test results from IR systems (65).

On this most important variable, the conclusions are as follows:

1. It may be expected that the greater the judges' subject knowledge, the higher will be their agreement on relevance judgments. Subject knowledge seems to be the most important factor affecting the relevance judgment as far as human characteristics are concerned. This finding underlines the importance of considering the stock of knowledge at hand, when considering relevance and people.
2. It has also been demonstrated that the level of judges' subject knowledge varies inversely with the number of documents judged relevant; conversely, the less the subject knowledge, the more lenient are their judgments.
3. Non-subject-oriented groups (e.g., subject information retrieval specialists and librarians) tend to assign relatively high relevance ratings. They will be inclined to provide a user with all or most of the relevant material that he himself would consider relevant and, in addition, some or considerably more material that he would not consider relevant. However, it may be expected that the ranking of documents as to degree of relevance will be similar for persons with extensive subject background (i.e., users) and for suppliers of information (i.e., delegates) with lesser subject backgrounds.
4. Familiarity with, and knowledge of, subject terminology has been shown to effect high relevance agreement.
5. It may be expected that a professional or occupational involvement with the problem giving rise to the query would increase agreement of relevance judgments among and between groups of subject specialists and suppliers of information. Increased professional involvement affects agreement among judgments, irrespective of the degree of subject knowledge.
6. The correlation in relevance agreements among people with high levels of subject expertise and the most professional involvement with the query has been found to be between .55 and .75; the correlation in relevance agreements among suppliers of information has been found to be between .45 and .60.
7. Differences in the intended use of documents may produce differences in relevance judgments,

suggesting that intended use becomes part of the query. This finding relates to Schutz's "interpretational relevances" and Wilson's "situational relevances."

8. Agreement as to what *is not* relevant may be expected to be greater than agreement as to what *is* relevant; judging relevance is not the same as judging non-relevance.

9. Tests of retrieval system performance, if of course they are well designed and controlled, may produce reliable comparative results within test experiments, regardless of relative instability of relevance judgments (instability within the range elaborated under previous conclusion 6.)

One of the major conclusions that can be drawn from experiments is that relevance judgments are not at all associated with a random distribution. Although it may appear that relevance judgment is a very subjective human process, it has associated with it some remarkable *regularity patterns.*

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