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ABSTRACT

Arguing that relevance judgments are fundamental to the design and evaluation of all information retrieval systems, and that a consensus on the definition of the central concept of relevance has not been reached, this paper begins by critically reviewing four approaches to the problem of defining relevance: (1) the system-oriented approach (relevance is defined as topicality, or matching); (2) the user oriented approach (relevance is defined as the relationship of information in a document to the research at hand, or in terms of user satisfaction); (3) the multidimensional approach (relevance is defined as topicality, as a concept contained within utility); and (4) the cognitive approach (which depends on concepts such as knowledge state, conceptual framework, and internal representation). It then introduces the user-concentric approach, which is based on three assumptions: relevance is a multidimensional concept based on the human judgment process; it is dependent on both internal (cognitive) and external (situational) factors; and it is intersubjective but nevertheless systematic and measurable. Currently being explored at Syracuse University, this new approach is described as a model which explores relevance in the context of the sense-making approach, and places the user, not the system, in the role of the central and active determinant of the dimensions of relevance. (25 references) (CGD)

RELEVANCE: THE SEARCH FOR A DEFINITION

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ABSTRACT

Although relevance judgments are fundamental to the design and evaluation of all information retrieval systems, information scientists have not reached a consensus in defining the central concept of relevance. This paper re-examines the viewpoints of major writers in the field, then introduces a new approach. We believe that relevance is a multidimensional concept; that it is based on the human judgment process; that it is dependent on both internal (cognitive) and external (situational) factors; and that it is intersubjective but nevertheless systematic and measurable. We suggest a different paradigm from the classic source-to-destination communication model of information retrieval. This user-centric cognitive model views the user -- not the system -- as the central and active determinant of the dimensions of relevance.

INTRODUCTION

Since information science first began to coalesce into a distinct discipline in the forties and early fifties, relevance has been identified as its fundamental and central concept. Yet serious questions about the definition and nature of relevance remain.

"Intuitively, we understand quite well what relevance means," says Saracevic. "It is a primitive 'y'know' concept, as is information for which we hardly need a definition. ...if and when any productive contact [in communication] is desired, consciously or not, we involve and use this intuitive notion of relevance." [1]

Despite, or perhaps because of, its intuitive nature, relevance has been used explicitly and implicitly in evaluation of information systems. In fact, a huge body of evaluation literature has accumulated that uses relevance without thoroughly understanding what it is. Another body of literature attempts, unsuccessfully, to define the concept. In the late fifties information scientists engaged in intense debates on theoretical and methodological aspects of relevance. In the sixties two major studies examined the factors that influence relevance. This research was summarized in the mid-seventies, and since then, overt interest has seemed to subside. Yet the need for a definition is more pressing than ever, for at least three reasons:

(1) Relevance is the basis of all information retrieval systems, including full-text systems, question-answering systems, database management systems, and knowledge-based systems. Increasingly complex information retrieval systems are being developed that promise to serve users faster, more efficiently, and more directly than ever. It is inevitable that these new systems will be evaluated, as have systems since the library card catalog, on the basis of human relevance judgments. Without a firmly established understanding of relevance, it seems difficult (if not

impossible) to make definitive statements about systems or system features or to make comparisons across systems.

(2) Among current developments are information retrieval systems that actually respond to the user's relevance judgments. Relevance feedback, for example, makes the user an integral part of the system. In such a system, relevance is no longer a reactive concept, to be used primarily in evaluation, but an active concept vital to the functioning of the system itself. But what is this "relevance" that is being actively used? That is, it seems necessary to understand what users "mean" by relevance if a feedback mechanism is to make best use of user involvement.

(3) Information scientists must finally establish a theoretical understanding of relevance as a fundamental concept, so that the discipline of information science can move on to other matters.

Two key questions are at issue here: What is relevance? And, what is the role of the user in judging relevance? In an attempt to revive interest in the problem of defining relevance, this paper critically reviews approaches to these questions and the assumptions on which they are based, then describes a recent approach that may offer a solution.

SYSTEM-ORIENTED APPROACHES

Information science is traditionally based on the classic model that describes communication as the transfer of a message from a source to a destination -- in information retrieval terms, from a system to a user. The practical goal of information science has been to design systems to retrieve information that satisfies the request of the user, that is, information that is relevant to the user. The clearest and most persistent definition of relevance is one of matching or topicality: whether the topic of the information retrieved matches the topic of the request.

Fundamentally, information retrieval systems have relied on the matching of words. Further enhancements have focused on counting or

measuring the frequency with which terms that describe the content of a document occur, or how relevant terms tend to cluster in certain linguistic patterns or sets. Considerations such as these are also important for systems design in natural language processing, automatic indexing and abstracting, and full-text retrieval. Many models are probabilistic, for example, those that assign numerical values or weights to the terms in documents according to their probability of being judged relevant by the user. Applications include systems that rank documents for the user in order of their relevance, and relevance feedback systems in which term weighting may be used to modify lists of documents retrieved as the search progresses. Still other models derive from formal logic, such as those concerned with developing decision rules for indexing.

Overall, these models, regardless of their complexity and sophistication, share a fundamental assumption of matching. Topical relevance lies at the heart of the design and evaluation of information retrieval systems. Topicality is both intuitively valid and practical: applicable, observable, and measurable.

But topicality is insufficient as a definition of relevance because, while it depends on matches between queries and documents (or document terms), it does not necessarily encompass the information needs of the user. Furthermore, a topical definition does not represent the full content and context of documents. Certainly the importance of the user in making the ultimate relevance decision has been recognized as far back as 1958 at the International Conference for Scientific Information in Washington, D.C. In separate papers, Vickery [2, 3] presents views on two kinds of relevance: relevance to a subject and user relevance. Relevance to a subject most closely fits the topicality definition, or matching queries with documents. In user relevance, the user decides how far to pursue the search for information.

USER-ORIENTED APPROACHES

After topicality, the term usefulness probably appears most often in the relevance literature. Usefulness generally refers to some way in which information retrieved fulfills a user's need. Saracevic [4] includes in his summary list of 16 definitions the notions that relevance is "a measure of usefulness of an answer" and "an indication of significance to an important purpose." Relevant materials or information include "ideas or facts so closely related to the problem at hand that disregarding them would alter the problem"; "ideas or facts useful in considering the matter at hand"; and "answers of use in current work."

Rees and Schultz [5], in their large-scale experimental study of the relevance judgment process, place relevance and usefulness in separate but overlapping classes. According to their definition, relevance is the relationship of information in a document to the research at hand. Relevance is contained within usefulness, which also relates to users' existing knowledge and individual characteristics. After post-experimental questioning of their subjects, however, Rees and Schultz conclude, "It is clear that the definitions of relevance and usefulness were not mutually exclusive, and to the degree that the judges were sensitive to this overlap, they may have experienced some difficulty in discriminating between the two terms."

Another approach defines relevance in terms of user satisfaction. Generally, satisfaction relates to the user's state of mind or personal attitude as expressed in response to some aspect or aspects of an information search. It is often operationalized as a measure in performance evaluations of information retrieval systems. Satisfaction measures tend to be compiled from questionnaires that ask users to rate their degree of satisfaction with widely varied aspects of search, retrieval system, and system environment. Thus satisfaction may be a composite that contains

judgments of relevance. Both theorists and system evaluators seem to agree that satisfaction is an extremely complex concept, one that relates system output and attributes of the system itself to the user's information need. [6, 7]

Many more terms (e.g., appropriateness, fit, aboutness, pertinence) have been used in attempts to establish a user-oriented definition of relevance. [8, 9, 10, 11, 12]. But taken together, these attempts appear to confuse rather than clarify the meaning of the concept. A more general approach is to define relevance as a relationship, as Saracevic [4] does in the form of an algorithm: "Relevance is the (A) gage of relevance of an (B) aspect of relevance existing between an (C) object judged and a (D) frame of reference as judged by an (E) assessor." With appropriate terms inserted from the lists he provides, the statement might read: "Relevance is a measure of utility existing between a document and a question as judged by a requester." This algorithm, Saracevic says, "demonstrate[s] almost every definition ever used for the concept of relevance."

In short, no single view has emerged as a "final" definition of relevance. But of the definitions described so far, all except topicality depend on the user -- not the system -- to determine what information is relevant. And all imply a definition of relevance as some sort of relationship or relationships.

MULTIDIMENSIONAL APPROACHES

The apparent complexity of the concept of relevance seems to point to a multidimensional definition. For example, Cooper [13] defines relevance as topicality, a concept contained within utility. Utility, he says, is a "catch-all concept" ... a "cover term for whatever the user finds to be of value about the system output, whether its usefulness, its entertainment or esthetic value, or anything else." Cooper does not isolate or test these factors systematically, but in several papers [13, 14, 15, 16] mentions

qualities such as novelty; informativeness; credibility (publication source, authorship, recency); importance or weighting of components in request; clarity (ease with which relevance can be detected by user or system); involvement with the system (time spent, effort expended); possible negative factors (boredom, unpleasantness occasioned by the content of the document); and possible esthetic factors (witty style, beauty of illustrations). Based on all these factors, Cooper's definition of utility might also be viewed as a multidimensional concept of relevance.

In the sixties, two major studies actually based on a multidimensional view identified sets of potential relevance variables and tested their effects and relationships. The studies of Rees and Schultz [5] and Cuadra and Katter [17], which each identified about 40 variables, yielded more collective insight into the factors affecting relevance than any one study since, but they failed to resolve the question of definition. They did, however, find the judge to play an important role.

Rees and Schultz [5] define relevance as "a relation between system responses and user request established by a judgment made by the user or his delegate." The results of their study show that individual differences most strongly affect relevance judgments. In their conclusion, Rees and Schultz say, "Although the initial search should be for variables related to the relevance assessments, the most fruitful findings will appear when statements are possible about personal characteristics which lead to, or cause, certain types of relevance ratings."

Cuadra and Katter [17] see the "judgmental phenomenon" of relevance as indicating, first, the relationship of a term or document to the user's field of interest (implicit use orientation); and second, the relationship between system output, such as a document, and the user's information requirement, either specified or assumed. The results of their study show the judge to play a central role in determining relevance. They conclude by

emphasizing the importance of understanding users' "real needs" and suggesting that a major priority for future research lies in developing models of user and situation.

The seventies were marked by the impressive efforts of Saracevic [1, 4] to establish a definitional framework for relevance as a theoretical construct through summarizing, refining, and developing earlier views. The notion of relevance, Saracevic [4] says, is directly connected to the model of information retrieval as a source-to-destination communication process. Relevance "is a measure of effective contact between a source and a destination." Using Cuadra and Katter's [17] framework, Saracevic groups all experimental variables from the literature into five major classes:

(1) documents and document representations;
(2) queries;
(3) judgmental situations and conditions;
(4) mode of expression (rating scales); and
(5) judges (people).

The most important category, Saracevic [4] says, is people: "It is clear that the other four classes of variables ... relate more or less to people in at least two respects: either how people (judges, users, user delegates, system operators, etc.) were affected by them in their judgment or how these variables fared from some action by people (e.g., relation between texts and answers, distribution of judgments over documents and document representations)."

When Saracevic synthesizes the results of the experimental studies, he concludes that subject knowledge is the most important variable concerning people: the less people know, the more items they judge relevant. Within groups of subjects, situational factors (e.g., professional involvement with the problem, intended uses of documents, the system being being evaluated/used) generally affect agreement in relevance judgments.

Unfortunately, major criticisms of relevance research cast doubt on even these findings. Saracevic [4] himself comments that experiments on

relevance have been conducted without significant connection to or from theories. Certainly control in experimental situations presents a difficult challenge. In evaluating the performance of retrieval systems and in studying user behavior, researchers typically use artificial test collections and simulated search conditions. They predetermine what are "relevant" documents or "correct" relevance judgments as standards for measurement. The assumption is that meaning is inherent in text and that experts are able to extract it and apply it to retrieval problems. Users, then, essentially are forced to translate their information needs into the standard categories of the existing information system. The results of these experiments do not necessarily shed light on the behavior of real users searching real collections in real situations.

COGNITIVE APPROACHES

A number of promising perspectives that apply to questions of relevance come from the psychological disciplines. Information scientists who have adopted and developed the approaches of cognitive psychology tend to view relevance judgments as intersubjective and constantly evolving phenomena. They see users as taking responsibility for -- and an active role in -- making judgments. Users' judgments, in turn, are affected by any or all internal factors (e.g., attitudes and prejudices) and external factors (needs and situations) that influence them as individuals. Cognitive approaches, which depend on concepts such as knowledge state, conceptual framework, and internal representation, clearly represent a trend away from system's views and toward user's views of relevance.

Saracevic [4] suggests these trends when he proposes three hypotheses:

(1) "Only the user himself may judge the relevance of the documents to him and his uses";

(2) "For the same user a relevance judgment may change over time";

(3) "Various types of judgments may exist because of the different purposes for which information is required."

These hypotheses not only center on the user, but also go beyond the user. They imply that relevance judgment depends entirely on the perception of the user and the situation of the moment. So far, these hypotheses have not been thoroughly tested.

On the other hand, several interesting theories have evolved that relate not to the definition of relevance per se, but to information needs and uses. These theories tend to look less at what is specified in information queries than at what is not.

For instance, Artandi [18] views information as a means of reducing uncertainty: "To reduce uncertainty information must be 'relevant' in the sense that it can be integrated and evaluated by the individual in terms of prior experiences (his existing state) and his possible future states and activities." An approach called anomalous states of knowledge (ASK), is described by Belkin, Oddy and Brooks [19]. ASK sees the user as being in an anomalous state of knowledge in which he actually may be unable to articulate what is needed to solve his problem. Taylor [20] describes the user-values approach, which focuses on the user's problem or problem situation; on perceptions of utility and value that the user brings to the system. Finally, the interdisciplinary sense-making approach, developed primarily by Dervin [21] concentrates on how people bridge cognitive gaps in order to make sense of their worlds. This approach allows an active role for the judge in a cognitive, non-physical environment in which conditions constantly change.

THE USER-CENTRIC APPROACH

Eisenberg, Nilan, and others at Syracuse University are currently exploring the concept of relevance in the context of the sense-making approach. [22, 23, 24] In their view, information need is how users see information helping them most effectively make sense of their individual

realities. Relevance is the user's connection to these realities. The Nilan and Eisenberg work is based on several assumptions:

(1) The user is an active creator of his own reality in a constantly changing environment;

(2) Relevance is a multidimensional concept involving a relationship between a user and the user's situation or environment;

(3) Relevance is a cognitive phenomenon that is highly intersubjective, but nevertheless systematic and measurable; and

(4) The user is the ultimate judge of relevance; the dimensions of relevance can only be explored from the user's perspective.

This approach is wholly user-oriented or "user-centric." It looks at users entirely in the context of their own situations. Their situations include, among other things, the information retrieval system. Because this approach builds exclusively on environments and values as perceived by the user, an appropriate technique for exploring the concept of relevance is to allow users themselves to generate their own definitions of relevance, that is, of the "connections" between information and information need. Data on these connections can be collected through open-ended questioning, and analyzed through methods such as content analysis to uncover underlying patterns. [24, 25]

In 1987, Nilan and Eisenberg [24] initiated an exploratory project with three different experimental settings: a focus group, individual interviews, and a supervised judgment task. In all three settings, users were asked to concentrate on their own real-life situations and to describe in their own words the connections they perceived between their information needs and the information retrieved. Responses generated in the focus group and individual interviews were tape-recorded and content-analyzed. The result was a list of 39 "qualities of relevance," or descriptions of relationships between information needs and products. Finally, in the task setting, subjects were given this list and asked to choose the qualities that applied to their

individual situations, then to rank the qualities they chose in order of importance.

Responses to the judgment task showed that the list was so complete that the open-ended "other" category was scarcely necessary. Among the "connections" on the list were statements that the information or document was available, had a good index, was current/timely, or had authority/prestige. With regard to themselves and their situations, subjects stated that the information gave evidence or authority for a position, solved the problem, was interesting or worth knowing, was esthetically pleasing, reduced anxiety, stimulated their imagination, or that, serendipitously, "I stumbled on something interesting."

Many of the factors Cooper and others had already suggested as contributing to relevance judgments, such as esthetics, appeared spontaneously in subjects' statements using this method. The factors that were gathered point to a definition of relevance both as a multidimensional and a systematic concept. The implication is that it is possible to establish a coherent set of evaluation criteria generated by users themselves. These criteria can then be incorporated in information retrieval system design.

The user-centric study was, again, exploratory. Subject pools were small, for instance, and biased toward academic information needs. But while Nilan and Eisenberg are still in the process of designing a large-scale project to test a user-centric definition of relevance, their early results show dramatic potential for the use of the user-centric model and appropriate qualitative analyses.

CONCLUSION

Until recently, little has been done to address the theoretical lack of connection between the realities of users and the realities of information

systems. Information science still has no definition of relevance nor a conclusive understanding of the role of the user in relevance judgment.

In this paper we have, however, introduced an approach that can serve as a foundation for exploration. The assumptions underlying the user-centric view of relevance extend beyond viewing the concept as a multidimensional, active, systematic phenomenon. It suggests fundamental changes in the theoretical approaches of information science. The communication paradigm (the source-to-destination model of information retrieval) is too linear, too system-oriented, to provide a realistic understanding of the human judgment process. The user-centric approach suggests new definitions not just for relevance, but for its related concepts of information retrieval system, information need, and information environment. Perhaps most important is a reconceptualization of information itself as something actively created by the individual.

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