Epistemology and the Socio-Cognitive Perspective in Information Science

Birger Hjørland
Royal School of Library and Information Science, DK-2300 Copenhagen S, Denmark. E-mail: bh@db.dk

This article presents a socio-cognitive perspective in relation to information science (IS) and information retrieval (IR). The differences between traditional cognitive views and the socio-cognitive or domain-analytic view are outlined. It is claimed that, given elementary skills in computer-based retrieval, people are basically interacting with representations of subject literatures in IR. The kind of knowledge needed to interact with representations of subject literatures is discussed. It is shown how different approaches or "paradigms" in the represented literature *imply* different information needs and relevance criteria (which users typically cannot express very well, which is why IS cannot primarily rely on user studies). These principles are exemplified by comparing behaviorism, cognitivism, psychoanalysis, and neuroscience as approaches in psychology. The relevance criteria implicit in each position are outlined, and empirical data are provided to prove the theoretical claims. It is further shown that the most general level of relevance criteria is implied by epistemological theories. The article concludes that the fundamental problems of IS and IR are based in epistemology, which therefore becomes the most important allied field for IS.

Introduction

There is more than one cognitive view in information science (IS), and these views have, in my opinion, changed over time. The discourse about cognitive views in IS originated in an interdisciplinary movement known as "the cognitive sciences" or even "the cognitive revolution" (cf. Gardner, 1985). This movement is often dated to about 1956 in psychology (e.g., by Gärdenfors, 1999). It is closely connected to the development of the field of artificial intelligence (AI) in computer science. An interdisciplinary field was established about 1975 with Norman and Rummelhart (1975) among the first books. The journal *Cognitive Science* began publication in 1977, and *The Cognitive Science Society* held its first annual meeting in 1979. These are some formal criteria of the establishment of cognitive science as an interdisciplinary field.

Socio-cognitive views can be understood as both alternatives to the cognitive sciences and as internal approaches or movements within the cognitive sciences. In other words, they are approaches that are supported by literature and traditions from outside cognitive science, but that are increasingly being presented and discussed within cognitive science. Timpka (1995), for example, is a researcher in AI who, under the label *cognition's context*, introduces different sociological perspectives:

> Historically, sociology has contained a substantial concern for cognition. Durkheim's analysis of collective representations, Marx' discussion of ideology and class consciousness and Weber's "verstehen" method all contained analyses and models of cognition. Even more pertinent for clinical cognition, Mead's theories of social cognition (Mead, 1934) describes the human self as divided into cognition and affect, where cognition emerges from the process of adjusting to the social environment. As a consequence, full cognitive capabilities cannot evolve without interaction in a community . . . (Timpka, 1995, pp. 388–389).

It is outside the scope of this article to present a historical and philosophical analysis of cognitive and socio-cognitive views in general. The focus will be on presenting a socio-cognitive view for IS, outlining its implications and providing empirical support for its validity.

Cognitive and Socio-Cognitive Views in Information Science

In 1977 Marc de May proposed a cognitive view for IS:

> that any processing of information, whether perceptual or symbolic, is mediated by a system of categories or concepts which, for the information processing device, are a model of his world. (de May, 1977, pp. xiv–xvii)

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I agree with this specific formulation. One could say that it corresponds to the hermeneutic claim that our understanding is determined by our preunderstanding. However, in unfolding this formulation major differences between traditional cognitive views and views of a socio-cognitive nature occur.

To understand this quotation we must know what categories and concepts are implied when it is used in IS. What categories and concepts are we talking about in information retrieval (IR)? The cognitive views often talk about *mental structures* or *mental models*. The Zeitgeist in information science was influenced by the concept of AI and the view that psychological experiments with humans could provide the basic knowledge that could be implemented in computers and in information systems.

About 1990 Lindsay and Norman's text (1977) was selected as a textbook for the master's degree in *the Royal School of Library and Information Science* in Copenhagen by Professor Peter Ingwersen, who argued and still argues for a cognitive view in IS. I take this fact as one indication of what Ingwersen's cognitive view meant at that time. I think that his view then represented an important trend in the Zeitgeist, namely the opinion that psychological experiments with human information processing would provide proper theoretical foundation for IS. Two basic and interconnected assumptions in this view—as in most cognitive views—have been

(1) Methodological individualism, the view that the focus is on the study of individual persons' cognitive functions, predominantly in the form of psychological experiments. About methodological individualism see, for example, Bhargava, (1998) and Segal (1998).
(2) Connections between mental models and neural, inborn structures in human beings (rationalism). This assumption is necessary if one wants to base AI on psychological mechanisms. Because of this second assumption there is a close relationship between cognitive sciences and neurosciences.

These assumptions are not explicitly discussed in Lindsay and Norman's text (1977), but they can easily be deduced from it when we look at the kinds of experiments presented and its coverage of neuroscientific material. The connection to rationalism can be established through the works of the linguist Noam Chomsky, one of the most influential researchers in the early period of cognitive science. He explicitly referred to the rationalistic tradition with René Decartes as a leading figure. Much research inspired by cognitive approaches does not, however, consider the neurological basis of cognitive processes. Often the main problem in cognitive research is the kinda of perspectives that are omitted because of implicit rationalistic assumptions.

About the same time I started to develop an alternative to the individualism and rationalism of the cognitive views more systematically (both *cognitivism* in general and *the cognitive view* developed by Ingwersen). My first major works on this issue were in Danish (Hjørland, 1991, 1993a). I have used different labels, especially the sociological-epistemological approach and the domain-analytic approach. A major presentation of the domain-analytic view was given in English in Hjørland and Albrechtsen (1995).

A central point in my approach is the claim that tools, concepts, meaning, information structures, information needs, and relevance criteria are shaped in discourse communities, for example, in scientific disciplines, which are parts of society's division of labor. A discourse community being a community in which an ordered and bounded communication process takes place. This communication is structured by a conceptual structure, by institutional enclosure, and by governance of discourse fora (see Wagner & Wittrock, 1991). This view changes the focus of IS from individuals (or computers) to the social, cultural, and scientific world. One important implication is that the relevant cognitive structures are of a historical rather than of a physiological nature. In developing this view I found support inside psychology from *the Cultural-Historical Approach* associated with names like John Dewey, L.S. Vygotsky, and A.N. Leontiev, also known as *Activity Theory* and *the Socio-cognitive View*. An up-to-date introduction to activity theory is Karpatschof (2000). In information science Jacob and Shaw (1998) provided a fine review of much of this research using the socio-cognitive view as a label.

My work is, in many respects, related to an approach developed by Rafael Capurro (e.g., 1985) and by Winograd and Flores (1986) emphasizing the hermeneutical aspects of IS and the social nature of knowledge. It is also related to views put forward by the approach known as *social constructionism* by Frohmann (1990), Tuominen (2001), and others. Tuominen's (2001) main argument against methodological individualism is that the assumption of a measurability of the mental models of an individual through discourse is wrong.

Inside cognitive sciences in general, similar approaches have been suggested and developed. According to Gärdenfors (1999), a corresponding change is *the pragmatic turn* of linguistics. In early cognitive science the role of culture and society in cognition was marginalized. For Chomsky and his followers, individuals are Turing machines that process syntactic structures according to a partly innate system of grammatical rules. Questions concerning the meaning of the words, let alone problems related to the use of language in communication, were seen as not properly belonging to a cognitive theory of linguistics. A new pragmatic tradition turned the classic cognitive approach upside down. Human actions and activities are here seen as the most basic entities; pragmatics consists of the rules for linguistic actions; semantics is conventionalized pragmatics; and finally, syntax adds grammatical markers to help disambiguate the meaning when the context does not suffice to do so.

In this way socio-cognitive views in many respects turn the cognitive view upside down. They are interested in individual cognition, but approach this from the social con-

text, not from the isolated mind or brain. They are not working inside-out, but outside-in. I find this development in agreement with a description given by Bogdan (1994, p. 187), who praised and found support and inspiration in two recent methodological innovations in cognitive science. "One is the classical top-down (ICM) analysis that recommends an explanatory progression from information task to the executing cognitive programs and then to the mechanisms running the programs. The other and more recent is the evolutionary analysis that treats cognition the way biologists treat any organ, namely, as an adaptation."

The reactions from Ingwersen and other people identifying themselves with the cognitive view in IS toward the suggestions put forward by the domain-analytic or socio-cognitive view have so far been difficult to interpret. Actually, in his inaugural lecture May 14, 2001, at the installation of professors at the *Royal School of Library and Information Science* in Copenhagen, Ingwersen also used the label *socio-cognitive* about his own view, just as he has referred to domain-analysis as his research interest in the newsletter *Biblioteksskolenyt* (2001, #1, p. 5). His cognitive view has not maintained its connection to cognitive psychology, which was claimed in the beginning of the 1990s. Although it is of different origin, Ingwersen's concept *polyrepresentation* is closely related to ideas presented by Hjørland (1993a, 1997) based on Pao and Worthen (1989) and Pao (1993). The socio-cognitive conception of relevance developed by Hjørland (1997), first cited by Ørom (2000), is now quoted in Ingwersen's inaugural lecture May 14, 2001.

All these facts suggest that the cognitive view (at least as held by Ingwersen) has approached the domain-analytic view. If this is true there should be no substantial disagreements, and we should all be socio-cognitivists today. Whether this is actually the case will be explored a little further in the next section.

Two kinds of Domain Analysis?

Lykke Nielsen (2000a, 2000b), in a recent presentation at ASIS, discusses domain analysis as a method in thesaurus construction. This presentation may cast some light on the difference between my version of domain analysis and the way in which this term has recently been connected to the cognitive view. Although I do find this research very important and qualified, I think, however, that it uses domain analysis in a sense different from what I intended when I introduced this concept.

The PowerPoint presentation (Lykke Nielsen, 2000b, p. 4) credits Ingwersen for this concept, while the pdf-file (2000a, p1) mentions several persons and writes:

> Hjørland (1997) operates with the concept of "domain analysis" on which system development and improvements should be based. Like Soergel, he primarily recommends what type of knowledge to gain about the information system and its users, but gives only few details about what investigative methods to use to collect the desired knowledge.

First, I do not find the accreditation of Ingwersen historically correct. My first use of "domain analysis" in English was Hjørland (1993b), to be followed by Hjørland and Albrectsen (1995). Soergel (as well as the other persons mentioned in the text) have to my knowledge not used this term or its underlying conceptions. The term domain analysis has been used earlier in computer science, where it can be traced back to Neighbors (1980). Among the people cited by Lykke Nielsen (2000a, 2000b), I claim to be the first person to have used this term and the underlying theory and methodology.

Second, the statement "Hjørland . . . gives only few details about what investigative methods to use to collect the desired knowledge," is a rather negative one, and it is in my opinion wrong. The whole idea of developing a view is of course to improve research in the field. If it does not contribute to this, it has simply failed. I claim to have contributed to the clarification and development of the methodology of knowledge organization (including thesauri and classification). I have uncovered four basic kinds of methods: (a) *rationalistic methods* (as known from, e.g., Ranganathan and the facet-analytic tradition); (b) *empirical methods* (as known from, e.g., the bibliometric method of co-citation analysis); (c) *historical methods* (see, e.g., Hjørland, 2000b); (d) *pragmatic methods*, focusing on goals and values, and connected to, for example, feminist and critical approaches to knowledge organization.

All these four methods, as well as their relative strengths and weaknesses, have been in focus in my research. They have been compared and discussed in detail in a case study of psychology (Hjørland, 1998b).

The methodology for thesaurus construction described in Lykke Nielsen (2000a) is a combination of group interviews and word association tests to collect data and content analysis and "discourse analysis" to analyze data. The "domain" or "discourse community" is a specific Danish pharmaceutical company. Given the purpose and conditions of this research, I have no serious objections to the methods used. On the contrary, I welcome this initiative as talented and relevant. We need very much this kind of information research that goes into foreign fields and develops tools for their optimal information gathering. I wonder, however, if the term *domain analysis* is well chosen and whether it is in accordance with my and with other people's use of this concept.

The data collection methods described in Lykke Nielsen (2000a) are well known in AI as techniques or methods of *knowledge elicitation*. If you are going to build an expert system, you have to get the expert knowledge from somebody or somewhere. An obvious solution is to elicit the needed knowledge from somebody considered an expert on the task or issue. Cooke (1994), for example, presents a variety of such knowledge elicitation techniques, including group discussions and free associations. Such methods have

primarily been considered of a psychological nature, while the domain-analytic methods that I have been a spokesman for have mainly been of a sociological and epistemological nature.

A central question is how to evaluate the domain knowledge of subject specialists. In the management of research libraries and disciplinary databases it is common practice to employ subject specialist to do the indexing and classification of documents as well as the construction and maintenance of systems for knowledge organization. The method to apply a subject specialist or an expert is, however, not to solve the methodological problems of knowledge organization, it only moves the question one step back: how does the subject specialist obtain this knowledge? What methods should subject specialists use in order to construct, for example, a thesaurus? What methods would information scientist as ourselves use to construct a thesaurus in our own field of expertise, information science? Information science should of course provide methodological guidelines for the construction of such systems, and not just assume that domain knowledge per se is sufficient. How much do experts agree? How much do domains differ in this respect? Are there more systematic kinds of disagreements related to, for example, theoretical views, paradigms, and epistemologies? What are the consequences of such meta-knowledge for the design of systems? Recent developments in AI emphasizes the importance of such problems:

> [E]xpert systems never reached the adroitness of human experts and they were almost never given the opportunity to have the decisive word in real cases. A fundamental problem is that such systems may incorporate an extensive amount of knowledge, but they hardly have any knowledge about the validity of their knowledge. Without such meta-knowledge, a system cannot form valid judgements that form the basis of sound decisions. As a consequence, expert systems have been demoted to the ranks and are nowadays called "decision support systems." (Gärdenfors, 1999)

Although the methods of knowledge elicitation used in Lykke Nielsen (2000a) seem well suited to the task of designing a thesaurus for a specific company, they are not quite as well suited for a domain analysis in my understanding. They are more related to the methodological individualism of the traditional cognitive view. A domain analysis should in its first stage consider not just one company, but a field developing and sharing common concepts, terms, and knowledge. There may be different layers of generalization of such fields from natural science to pharmacology, to neuropharmacology, and further to different kinds of specialization within neuropharmacology (subject specialization as well as specialization related to forms of basic and applied research, e.g. clinical neuropharmacology). The next step in domain analysis is to investigate the nature and structure of the knowledge and communication at the chosen level of specialization.

The approach applied by Lykke Nielsen (2000a) and "the cognitiv view" may, however, be considered supplementary to other approaches to domain analysis. In a forthcoming publication (Hjørland, 2002) I discuss the relative strength and weaknesses of 11 approaches to the analysis of a domain: (1) producing literature guides; (2) producing special classifications; (3) research on indexing and retrieving specialties; (4) empirical user studies; (5) bibliometrical studies; (6) historical studies; (7) document and genre studies; (8) epistemological and critical studies; (9) terminological studies, LSP, discourse studies; 10) studies of structures and institutions in scientific communication; and (11) domain analysis in professional cognition and artificial intelligence. The last approach is the approach applied in Lykke Nielsen (2000a). These 11 approaches do not, however, have the same status. Some approaches (e.g., epistemological studies) are necessary to interpret the results from other approaches.

Some important aspects of how the domain analytic view looks at information retrieval (IR) and analyzes subject domains are illuminated in the rest of this article. Many important aspects cannot, however, be addressed in this article, but must await forthcoming publications.

Information Retrieval (IR)

In IR humans are interacting with many different layers, for example:

(1) They are interacting with a personal computer (PC or MAC) and its operating system.
(2) They are interacting with a remote computer system (e.g., *Dialog*) and with its specific search engine and file organization.
(3) They are interacting with document representations (e.g., bibliographical records).
(4) They are interacting with representations of the subject literature in one or more domains (which can be more or less homogeneously or merged).

To perform, IR users must have adequate knowledge of all layers. (In terms of the cognitive view, users must have adequate mental models of all layers). It is extremely important to separate these layers analytically. Elementary courses in IR focus on providing good "mental models" of the computer layer (e.g., inverted files, Boolean logic, word, and phrase indexing, and so on). Much more important for questions of indexing and retrieval are, however, "mental models" of the subject literature.

Given elementary skills in computer-based retrieval, users are essentially interacting with representations of *the subject literature* in one or more domains. This is in my opinion an elementary, yet rather neglected fact.

The problems of IR are by their nature extremely difficult. How can one identify, for example, all relevant documents about a certain train accident in the world's bibliographical and full-text databases? The searcher will think of some databases and some obvious terms, and there is a good chance that he will retrieve *some* relevant documents. How-

ever, what is not so obvious to a searcher is that many other relevant documents will not contain the terms "train" and "accident" or obvious synonyms of those terms. Relevant documents may describe events leading to the accident that are not terminologically linked to documents about the accident itself. Then retrieval is not just a matter of the creative expressiveness of natural language, but it is also a matter of real knowledge of what is searched for (e.g., the accident). In the process of retrieval, searchers must learn about the object which they are seeking information about, and this subject knowledge must then be fed into the retrieval process to expand the search criteria ("iterative searching"). For example, an accident could be caused by a failure in a certain kind of signal, so the name of the manufacturer of the signal could be a relevant search term. No linguistic theory can provide such knowledge. Searchers thus face the problem of predicting three interacting levels of problems:

(1) What is in reality? For example, causes of train accidents. This is substantive knowledge. At the most fundamental and general level this is ontological knowledge.
(2) What is known and described in a way so that it can be retrieved and trusted? For example, engineering studies of train accidents and newspaper reports on train accidents? These are problems related to the theory of knowledge, science studies, and the theory of information sources.
(3) How is recorded knowledge described? For example, engineering terminology, legal language, and ordinary language; knowledge about document composition and discourse communication. This is especially terminological, linguistic and library and information science knowledge.

Such knowledge is not the same as subject knowledge as ordinarily taught at universities although people with subject knowledge usually have implicit knowledge about methodological problems, publication patterns, and terminology. Normally, however, they are not experts in such issues. Theories of information seeking and retrieval should, however, provide more explicit knowledge of such questions. Information scientists studying bibliometric patterns, terminological problems (e.g., thesauri), etc., have some advantages in relation to ordinary subject specialists in this respect.

So far, these problems have not been seriously theoretically addressed in information science but mostly been approached by common sense approaches to ontology, epistemology, and text theory. Controlled systems for information selection and vocabularies normally reduce the searchers' load of predicting such knowledge. Retrieval of documents on, for example train accidents, is very different in a dedicated journal or database about accident research and prevention compared to a merged journal or database. The cognitive and social organization of knowledge in disciplines and literatures facilitates greatly the retrieval of information by reducing the semantic distances between documents and searchers (and in the variance among the documents). A well-designed thesaurus could provide information about, for example, the manufacturer of signals.

As mentioned above, a core problem in IR is the adequate "mental modeling" of subject literatures. What categories and concepts are we talking about? In interacting with subject literatures, users are interacting among other things with

(1) Different kinds of knowledge fields with different social and cognitive organization.
(2) Different languages for special purposes (LSP)
(3) Different kinds of research methods
(4) Different kinds of, among other things, primary, secondary and tertiary documents
(5) Different patterns of cognitive authority.
(6) Different *semantic distances* between questions and documents (cf. Brooks, 1995).

Basically all these issues are social constructions that reflect both the object of research (an objective reality) and prevailing norms influencing the scientific communities. The most fundamental and general understanding of these issues is provided by the theories of knowledge, i.e., epistemological theories.

Paradigms and Epistemologies

In domain analysis, we are less inclined to speak about mental models and more inclined to talk about knowledge, (pre)understanding, theories, paradigms, and epistemologies. We mainly see the individual person as influenced by different theories, epistemologies, and paradigms, which are very often partly unconscious or neglected by the individual. Paradigms, theories, and epistemologies can be studied by philosophical, historical, sociological, bibliometric, and other approaches. Actually, *Journal of the American Society for Information Science and Technology* (JASIST) is preparing a special topic issue: Visualization of scientific paradigms. The term paradigm is mostly credited Kuhn (1962, 1970). Kuhn did not, however, accept different approaches in the social sciences as paradigms. I use the term in the same way as the Danish sociologist Heine Andersen:

> The paradigm concept and its place in social science have been discussed extensively. I use it as defined by Tjörnebohm (1974), to grasp systems of (explicit or implicit) basic assumptions and epistemic ideals in scientific disciplines. A paradigm is a superindividual structure of meaning, which is formed and reproduced in disciplinary socialization, teaching, and scientific communication. I distinguish between the following components of paradigms: (1) ideals and beliefs about science, such as epistemic goals methods and criteria in the production and evaluation of scientific results inside the discipline; (2) world view hypotheses, including basic social ontological assumptions about the part of the world studied inside the discipline, and

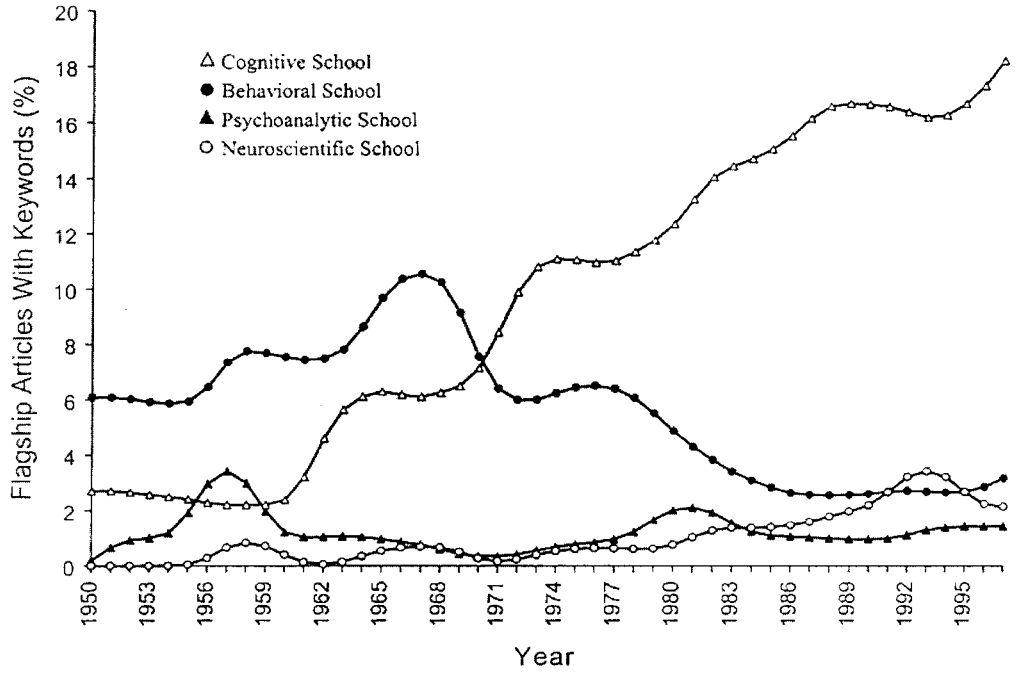

FIG. 1. Percentage of articles published in the Flagship Publications that include keywords relevant to the cognitive, behavioral, psychoanalytic, and neuroscience schools (Note: a smoothing function was used to transform the raw data.) © 1999 by the American Psychological Association. Reprinted with permission.

> (3) ideals concerning the extrascientific significance of knowledge produced inside the discipline, such as significance for society and culture, for practical use, and for enlightenment. (Andersen, 1999, p. 89)

Figure 1 above shows an empirical example of how different approaches or paradigms in modern psychology have developed from 1950–1995 (source: Robins, Gosling, & Craik, 1999, p. 122). The figure shows that from about 1971 cognitivism has replaced behaviorism as the dominating paradigm in psychology (thus documenting my claim about the historical nature of cognitive structures). It also illuminates the status of the psychoanalytic and the neuroscientific schools in psychology.

All schools are very large and diversified structures influenced by many views. There also have similarities and some mutual overlap. One should, therefore, be careful with reducing a psychological school to just one epistemological theory. Given this reservation, there are clear connections between paradigms and epistemologies. Behaviorism is closely related to classical empiricism (and to logical positivism), whereas cognitivism is closer to classical rationalism. By knowing such epistemological theories, scholars can interpret large patterns of historical influence just as they can formulate some basic advantages and disadvantages in different positions that have been learned through the history of science. It is also possible to draw some implications on this basis. These epistemological theories are simply the best *general* models we have. Their importance is widely recognized. This can be seen, for example, in the demand that many scholars and (social) scientist have to take courses in the philosophy of science as a part of their training. Although paradigms and epistemologies are much more visible in some fields (e.g., the social sciences) compared to other fields (e.g., chemistry and biology) it is my working hypothesis that they are *always* operating on some level, and that this level is what can be generalized about information needs and relevance criteria across domains.

Even if epistemological theories do have major limitations, my argument is that they are the best "cognitive models" available: that it is highly problematic to substitute such epistemological theories with psychological ones, which implies a universal nature. In fact, this latter approach has in my opinion brought IS down a very long blind alley that has had serious consequences for our discipline.

We should regard the theoretical developments shown in Figure 1 as developments in the cognitive models or structures of the psychologists seeking information and producing knowledge in this period. Such "models" are, of course, individual: we may have as many "mental models" as we have people. We need, however, to establish more general frameworks if we want to develop any general knowledge in IS. As already mentioned, it is my claim that epistemological theories provide us with the most generalizable "mental models."

Some individuals define their assumption in explicit theses. For example, in 1913 the behaviorist J.B. Watson formulated his (and thus behaviorism's) assumptions in a programmatic article (Watson, 1913). His basic thesis was that psychology is a natural science that studies the observable behavior of men and animals (stimuli and responses,

TABLE 1. Information needs as regarded from two epistemological positions

"Behavioral science approach" to information needs (Positivistic epistemology)	"Scholarly approach" to information needs (Hermeneutic epistemology)
Trying to measure information needs, by, for example, interviews or bibliometric patterns. Seeking general patterns among variables. Implicit assumption: universalism.	Reading and interpreting papers, studying their sources and reception in the literature, evaluating authors' conceptual horizon, comparing them with each other, and studying their development and how they are influenced. Historizising. Implicit assumption: cultural and domain relativism.

S-R psychology). Watson's view was already modified in very important ways in 1932 by the neobehaviorist Tolman (Tolman, 1932). He introduced "intervening variables" and thus the study of nonobservable entities (S-O-R psychology).

However, the great majority do not explicate their views nor do they express their consent to any formulated view. The extremely influential psychologist R.S. Woodworth (1939) asked himself whether he was a behaviorist. His answer was that he didn't know and didn't much care (quoted from Danziger, 1997, p. 159). The defining, classification, labeling, and evaluating activities in relation to such schools or "mental models" are mostly done by historians and philosophers of science. *They* are the real experts in this matter.

The fact that many scientists are not engaged in epistemological considerations has been explained by Kuhn (1962, 1970). Scientists do not need to spend their time on such issues unless they encounter a crisis in the research program. This has both positive and negative consequences for IS. The negative side is that it may be difficult to explain to the users why it is important. The positive side is that information scientists have an opportunity to relate information seeking and IR to research methodology and epistemology and thus develop a more unique kind of expertise that can be taught to users.

What is important to realize is that even though the epistemological approach may seem difficult and problematic, it may be the only way forward. Epistemology is the interpretation and generalization of scientists' own collective experience.

Information Needs

In the cognitive view information needs are considered to be something that develops in the individual (e.g., Taylor, 1968). In the domain analytic and socio-cognitive view information needs are considered to be caused by social- and cultural factors. Information needs may be compared with educational needs. Both kinds of needs develop to master some problems about which some knowledge has already been produced. Just as students are often unable to express their own educational needs, users of information systems are also often unable to specify their information needs (what information turns out to be relevant to solve a given problem). Information need is connected with the relevance concept. The expression: "N has an information need" is the same as "Documents or information of relevance to N can be found" (if a person or an organization has a need for which information has not yet been produced, one should speak about a need for research or information production). The following example shows how information needs and relevance criteria may not be recognized:

> [A] student solving a geometry problem involving a right-angled rectangle may not see the connection to the Pythagorean Theorem. (Lakemeyer, 1997, p. 138)

Information needs depend on the problems to be solved, the nature of available knowledge, and the qualifications of the user. Because most information problems are highly complex, the information needs tend to be socialized by

TABLE 2. Simplified relevance criteria in four psychological paradigms.

Behaviorism	Cognitivism	Neuroscience	Psychoanalysis
Relevant: Information about responses to specific kinds of stimuli. Kind or organism are of minor importance. (High priority to intersubjective controlled data.)	Relevant: Information about mental information mechanisms and processing. Analogies between psychological and computer processes. Measures of channel capacities, etc.	Relevant: Information correlating brain processes or structures with forms of behavior or experience.	Relevant: Information about dreams, symbols, mental associations, personal meanings associated with stimuli, etc. Data collected in therapeutic sessions by trained therapists who can interpret the data (thus giving lower priority to intersubjective controlled information).
Nonrelevant: Introspective data, data referring to mental concepts, experiences, or meanings of stimuli. (Information about brain processes.)			

TABLE 3. Core journals associated with four psychological paradigms (from Robins, Gosling, & Craik (1999).

Core Behavioristic Journals
Journal of the Experimental Analysis of Behavior 1958–.
Behaviour Research and Therapy 1963–.
Journal of Applied Behavior Analysis 1968–.
Behavior Therapy 1970–.
Core Cognitivistic Journals
Cognitive Psychology 1970–.
Cognition 1972–.
Memory & Cognition 1973–.
Journal of Experimental Psychology: Learning, Memory, and Cognition 1975–.
Core Neuroscientific Journals
Journal of Neurophysiology 1938–.
Annual Review of Neuroscience 1978–.
Trends in Neurosciences 1978–.
Journal of Neuroscience 1981–.
Core Psychoanalytic Journals
International journal of psychoanalysis, 1920–.
Psychoanalytic Quarterly, 1932–.
Journal of the American Psychoanalytic Association, 1953–.
Contemporary Psychoanalysis, 1964–.

various theoretical influences and "paradigms." The information demanded by users is an expression of their subjective information needs, which may thus be different from their real or objective needs.

An example: Bateson, Jackson, Haley, and Weakland (1963) formulated the theory that schizophrenia was caused by double-binding communication between mother and child. This theory is opposed to most psychiatric theories that suppose that it is caused by physiological or chemical factors. In the first case, family studies are needed or relevant for both research in and treatment of schizophrenia. In the second case, pharmacological studies are relevant.

Two different theories on any issue *imply* different information needs and relevance criteria on the deepest level. The information need is thus formed by the different theoretical views on a specific issue produced by persons in a society. In a given discourse community there are always more or less conflicting views of what is needed or relevant. The predominant view is reflected in the curricula of educational programs, in the priorities in research programs, in the editorial priorities in scientific journals, in the users' selection of information channels, in criteria for selecting journals to be indexed in databases, and so on. As paradigms develop or change, such priorities are formalized or changed. Individuals who disagree with the predominant view must work harder to get the alternative information and try to change the prevailing view.

People may have many information needs with very complicated relations to each other. A more precise need arises when a decision is made to write a paper. From that point and until the paper is printed, the author seeks information, selects information, and makes decisions about what to cite in the paper. The references in the paper itself represent only one stage in the development of the author's information needs. However, the references in the published paper are the most tangible, public, and available expression of how he has seen and resolved his own needs. People, who are used to reading and interpreting papers can evaluate authors' conceptual horizons, compare them with each other, and study their development and how they are influenced. In this way scholars may have other methods than behavioral ones to determine "information needs." Scholars would, however, be very reluctant to the whole idea of measuring or determining information needs in the way this is attempted by the behavioral approach. What they have a tradition doing is to study the reception and historical impact of different works and theories in different countries, periods, disciplines, and other socio-cultural contexts. This method is a kind of *reception analysis*. There are, thus, two very different approached based on different epistemologies (Table 1).

The methodological ideal in positivistic traditions is intersubjectivity (replicability by other researchers). This makes the study of information needs "objective" in one sense of this word. However, what can be studied in this way are only subjective expressions of the information needs of individuals. We here have a paradoxical problem: The "strong," "objective" positivist approaches can only uncover the subjective expressions and, therefore, imply a strong tendency toward subjectivism and subjective idealism. On the other hand, the "soft," "subjective" interpretative methods of a hermeneutic nature may uncover the ideological basis of the subjective expressions of information needs and thus in the end reflect a more objective reality. In this way the meaning of the word objectivity in relation to research methods is turned upside down.

Relevance

In information science a psychological understanding of relevance has dominated. Relevance is studied by asking users what documents they consider relevant or asking them about their relevance criteria. Cohen (1994) suggests, however, that nonconversational relevance is a relation between a true proposition and an askable question. When someone tells you a reason for accepting a particular proposition, the validity of the reason does not depend on the success of the argument. The reason may be valid even if you yourself fail to be convinced, or it may be invalid even though it in fact convinces you. Correspondingly, you may learn the truth from a proposition that is relevant to your inquiry without recognizing that it is relevant, or you may think it relevant even though it is not. By implication, the empirical study of users' relevance criteria is not sufficient, but should, as shown by Cohen (1994), take domain specific "covering laws" into consideration.

Schools or "paradigms" share some meta-theoretical assumptions, and thus some more general relevance assumptions or criteria. Thus, the relevance criteria of, for example, behaviorism, cognitivism, psychoanalysis, and neuro-

TABLE 4. Most cited sources in core behavioral journals.

About schizophrenia				In 1999 (record 1–278 of 302)			
DIALOG RANK Results RANK: S24/1–52 Field: CW = File(s): 7 (Rank fields found in 52 records—328 unique terms)				DIALOG RANK Results RANK: S28/1–278 Field: CW = File(s): 7 (Rank fields found in 275 records—1778 unique terms)			
RANK	No.	Items	% Ranked Term	RANK	No.	Items	% Ranked Term
1	10	19.2%	AM J PSYCHIAT	1	94	34.2%	BEHAV RES THER [Core Behavioristic Journal]
2	10	19.2%	ARCH GEN PSYCHIAT	2	80	29.1%	J CONSULT CLIN PSYCH
3	9	17.3%	SCHIZOPHRENIA B	3	72	26.2%	J EXP ANAL BEHAV [Core Behavioristic Journal]
4	8	15.4%	BRIT J PSYCHIAT	4	72	26.2%	PSYCHOL BULL
5	8	15.4%	SCHIZOPHRENIA BULL	5	65	23.6%	J APPL BEHAV ANAL [Core Behavioristic Journal]
6	7	13.5%	DIAGN STAT MAN MENT	6	64	23.3%	BEHAV THER [Core Behavioristic Journal]
7	7	13.5%	J ABNORM PSYCHOL	7	60	21.8%	J ABNORM PSYCHOL
8	7	13.5%	J NERV MENT DIS	8	56	20.4%	ARCH GEN PSYCHIAT
9	5	09.6%	J CONSULT CLIN PSYCH	9	52	18.9%	DIAGN STAT MAN MENT
10	5	09.6%	PSYCHOL BULL	10	51	18.5%	CLIN PSYCHOL REV
11	4	07.7%	CLIN PSYCHOL REV	11	50	18.2%	J EXPT ANAL BEHAVIOR [=3]
12	4	07.7%	HOSP COMMUNITY PSYCH	12	48	17.5%	PSYCHOL REV
13	4	07.7%	PSYCHIAT RES	13	47	17.1%	AM J PSYCHIAT
14	4	07.7%	SCHIZOPHR RES	14	39	14.2%	AM PSYCHOL
15	4	07.7%	SOCIAL SKILLS TRAINI	15	37	13.5%	BRIT J PSYCHIAT
16	3	05.8%	AM PSYCHOL	16	37	13.5%	J ANXIETY DISORD
17	3	05.8%	BEHAV RES THER [Core Behavioristic Journal]	17	35	12.7%	J EXP PSYCHOL ANIM B
18	3	05.8%	BEHAV THER [Core Behavioristic Journal]	18	33	12.0%	J EXPT ANAL BEHAV [=3]
19	3	05.8%	BIOL PSYCHIAT	19	31	11.3%	J PERS SOC PSYCHOL
20	3	05.8%	BRIT J SOC CLIN PSYC	20	29	10.5%	ANIM LEARN BEHAV
21	3	05.8%	J APPL BEHAV ANAL [Core Behavioristic Journal]	21	29	10.5%	COGNITIVE THER RES
22	3	05.8%	J CLIN PSYCHOPHARM	22	24	08.7%	BEHAV MODIF
23	3	05.8%	J PSYCHIAT RES	23	24	08.7%	J BEHAV THER EXP PSY
24	3	05.8%	PSYCHIATRY	24	23	08.4%	J EXPT PSYCHOL ANIMA
25	3	05.8%	PSYCHOL MED	25	21	07.6%	BRIT J CLIN PSYCHOL
26	3	05.8%	SCALE ASSESSMENT NEG	26	21	07.6%	LEARN MOTIV
27	3	05.8%	SCHIZOPHRENIA	27	21	07.6%	RES DEV DISABIL
28	3	05.8%	SCIENCE	28	19	06.9%	SCIENCE
29	3	05.8%	SOC PSYCH PSYCH EPID	29	18	06.5%	PSYCHOL REC
30	2	03.8%	ACTA PSYCHIAT SCAND	30	18	06.5%	PSYCHOL REP

science are very different even when they work on the same problem (e.g., schizophrenia) (Table 2).

As shown below these approaches have their own dedicated journals, and have very strong tendencies to use (and cite) information related to their own views and journals. Robins, Gosling, and Craik (1999) identified the following core journals in each of these four approaches (Table 3):

I have selected each of these clusters of journals in the *Social Sciences Citation Index* and combined them with schizophrenia as a title word. Then the resulting sets were ranked according to most cited work. The same sets were also limited to the printing year 1999, to limit computer expenses. The resulting search sets are shown in Appendix 1. On the basis of this search profile, I produced the following tables showing for each approach the ranking of the information sources most often cited (Tables 4–7):

Discussion

The general citation patterns from 1999 shown in the right columns are the most clear indicators of the tendency of different approaches to use information sharing the same basic view. Of the six highest ranked sources from *core behavioral journals* the four came from the same core behavioral journals and none were related to another approach. Of the seven highest ranked sources from *core cognitive journals* the four came from the same core cognitive journals and none were related to another approach. Of the 17 highest ranked sources from *core neuroscience journals* four came from the same core neuroscience journals and the rest clearly came from other neuroscience journals or from high prestigious general science journals such as *Nature* and *Science*. Of the five highest ranked

TABLE 5. Most cited sources in core cognitive journals.

About schizophrenia				In 1999 (record 1–278 of 278)			
DIALOG RANK Results				DIALOG RANK Results			
RANK: S25/1–2 Field: CW = File(s): 7 (Rank fields found in 2 records—70 unique terms)				RANK: S29/1–278 Field: CW = File(s): 7 (Rank fields found in 275 records—2405 unique terms)			
RANK	No.	Items	% Ranked Term	RANK	No.	Items	% Ranked Term
1	2	100.0%	BRAIN	1	197	71.6%	PSYCHOL REV
2	2	100.0%	NEUROPSYCHOLOGIA	2	196	71.3%	J EXP PSYCHOL LEARN [Core Cognitive Journal]
3	2	100.0%	PSYCHIAT RES	3	188	68.4%	MEM COGNITION [Core Cognitive Journal]
4	2	100.0%	PSYCHOL MED	4	149	54.2%	COGNITIVE PSYCHOL [Core Cognitive Journal]
5	2	100.0%	SCHIZOPHR RES	5	128	46.5%	J EXP PSYCHOL GEN
6	2	100.0%	SCHIZOPHRENIA BULL	6	128	46.5%	J MEM LANG
7	1	50.0%	ACTA PSYCHIAT SCAND	7	118	42.9%	COGNITION [Core Cognitive Journal]
8	1	50.0%	AGENCY ITS ROLEMENT	8	106	38.5%	J EXPT PSYCHOL HUMAN
9	1	50.0%	AM J PSYCHIAT	9	104	37.8%	J EXPT PSYCHOL LEARN
10	1	50.0%	AM PSYCHOL	10	103	37.5%	J VERB LEARN VERB BE
11	1	50.0%	ARCH GEN PSYCHIAT	11	88	32.0%	J EXP PSYCHOL
12	1	50.0%	AUTISM EXPLAINING EN	12	82	29.8%	PSYCHOL BULL
13	1	50.0%	BEHAVIORAL BRAIN SCI	13	77	28.0%	J EXP PSYCHOL HUMAN
14	1	50.0%	BIOL PSYCHIAT	14	76	27.6%	PSYCHOL SCI
15	1	50.0%	BRIT J CLIN PSYCHOL	15	75	27.3%	SCIENCE
16	1	50.0%	BRIT J DEV PSYCHOL	16	73	26.5%	Q J EXP PSYCHOL A
17	1	50.0%	BRIT J PSYCHIAT	17	72	26.2%	PSYCHON B REV
18	1	50.0%	BRIT J PSYCHOL	18	69	25.1%	PERCEPT PSYCHOPHYS
19	1	50.0%	CHILD DEV	19	60	21.8%	PSYCHOL LEARN MOTIV
20	1	50.0%	CHILDRENS THEORIES M	20	55	20.0%	J EXPT PSYCHOL GENER
21	1	50.0%	CHILDS THEORY MIND	21	48	17.5%	ATTENTION PERFORM
22	1	50.0%	COGNITION	22	47	17.1%	AM J PSYCHOL
23	1	50.0%	COGNITIVE DEV	23	47	17.1%	CHILD DEV
24	1	50.0%	COGNITIVE NEUROPSYCH	24	46	16.7%	BRIT J PSYCHOL
25	1	50.0%	COGNITIVE PSYCHOL	25	46	16.7%	NATURE
				26	42	15.3%	B PSYCHONOMIC SOC
				27	40	14.5%	ACTA PSYCHOL
				28	40	14.5%	COGNITIVE SCI
				29	38	13.8%	CAN J PSYCHOL
				30	37	13.5%	AM PSYCHOL

sources from *core psychoanalytic journals* the four came from the same core psychoanalytic journals. The number one ranked source was Sigmund Freud's Standard Edition, also clearly a psychoanalytic source.

If we limit our search to, for example, *schizophrenia*, the samples are much smaller and the distribution somewhat less clear, but they still confirm our thesis. The *core behavioral journals* have as most cited sources general journals in psychiatry, general journals in psychology, and special journals devoted to schizophrenia research. Still, however, three journals from the set of core behavioristic journals are cited more than journals identified as core journals in other approaches. In the set of *cognitive journals* only two articles were on schizophrenia and the data thus not interpretable (the most cited sources in fact being neuroscientific). In the set of *neuroscientific journals* other neuroscientific journals together with general science, general psychiatric, general psychological and general schizophrenia journals are the most cited sources. In *psychoanalysis* there is a very high concentration on specific psychoanalytic sources, which indicates that the degree of consensus and concentration of information sources vary from one approach to another. Also some approaches are much more connected to "general" journals than others, which indicates that some approaches have a higher degree of influence, and is much more main stream compared to other approaches. In the case of psychoanalysis there seems to be a low degree of integration between general scientific, psychiatric, or psychological information sources. This could be seen as a tendency towards isolationism or lack of contact with mainstream research. It is important to remember, however, that there is no neutral platform from which the different positions can be evaluated. Main stream tends to look as the most scientific, objective, fruitful, and correct approach, but that can change, and scientific questions should never be decided by opinion polls but by careful considering of the arguments. Critical researchers as, for example, social constructionists, can sometimes uncover strong arguments for why a certain point of view is predominant despite a problematic scientific foundation (Danziger (1990, 1997) is one example of a very qualified critique of mainstream psychology).

TABLE 6. Most cited sources in core neuroscience journals.

DIALOG RANK Results

RANK: S26/1–41 Field: CW = File(s): 7 (Rank fields found in 40 records—292 unique terms) Page 1 of 37

RANK	No.	Items	Term
1	16	40.0%	LANCET
2	16	40.0%	TRENDS NEUROSCI
3	15	37.5%	ARCH GEN PSYCHIAT
4	15	37.5%	BRIT J PSYCHIAT
5	15	37.5%	SCIENCE
6	13	32.5%	AM J PSYCHIAT
7	12	30.0%	NATURE
8	9	22.5%	BIOL PSYCHIAT
9	8	20.0%	DEMENTIA PRAECOX GRO
10	7	17.5%	LIFE SCI
11	6	15.0%	ARCH GEN PSYCHIATRY
12	6	15.0%	J NERV MENT DIS
13	6	15.0%	PSYCHOPHARMACOLOGY
14	5	12.5%	BRIT MED J
15	5	12.5%	P NATL ACAD SCI USA
16	5	12.5%	PSYCHOL MED
17	5	12.5%	TRANSMISSION SCHIZOP
18	4	10.0%	ACTA PSYCHIAT SCAND
19	4	10.0%	BRAIN RES
20	4	10.0%	J NEURAL TRANSM
21	4	10.0%	J PSYCHIAT RES
22	4	10.0%	PSYCHOL BULL
23	4	10.0%	PSYCHOPHARMACOLOGIA
24	4	10.0%	SCHIZOPHR B
25	4	10.0%	SCHIZOPHRENIA B
26	4	10.0%	SCHIZOPHRENIA BULL
27	3	07.5%	AM J MED GENET
28	3	07.5%	ANN NEUROL
29	3	07.5%	BRAIN
30	3	07.5%	DEMENTIA PRAECOX PAR
31	3	07.5%	DIAGNOSTIC STATISTIC
32	3	07.5%	EUR ARCH PSY NEUR SC

DIALOG RANK Results

RANK: S30/1–42 Field: CW = File(s): 7 (Rank fields found in 42 records—646 unique terms)

RANK	No.	Items	% Ranked Term
1	36	85.7%	J NEUROSCI [Core Neuroscience Journal]
2	30	71.4%	SCIENCE
3	28	66.7%	NATURE
4	25	59.5%	P NATL ACAD SCI USA
5	24	57.1%	BRAIN RES
6	23	54.8%	J NEUROPHYSIOL [Core Neuroscience Journal]
7	22	52.4%	EXP BRAIN RES
8	17	40.5%	BEHAV NEUROSCI
9	15	35.7%	BEHAV BRAIN RES
10	15	35.7%	NEUROREPORT
11	14	33.3%	NEURON
12	14	33.3%	SOC NEUR ABSTR
13	12	28.6%	CURR OPIN NEUROBIOL
14	12	28.6%	J COGNITIVE NEUROSCI
15	12	28.6%	J COMP NEUROL
16	12	28.6%	TRENDS NEUROSCI [Core Neuroscience Journal]
17	11	26.2%	ANNU REV NEUROSCI [Core Neuroscience Journal]
18	11	26.2%	BRAIN
19	11	26.2%	CEREB CORTEX
20	11	26.2%	NEUROPSYCHOLOGIA
21	11	26.2%	PSYCHOL BULL
22	11	26.2%	PSYCHOL REV
23	10	23.8%	NEUROSCIENCE
24	9	21.4%	J COMP PHYSIOL PSYCH
25	9	21.4%	J EXP PSYCHOL HUMAN
26	9	21.4%	NEUROLOGY
27	9	21.4%	NEUROSCI LETT
28	8	19.0%	ANNU REV PSYCHOL
29	8	19.0%	J PHYSIOL LONDON
30	8	19.0%	NEUROBIOL LEARN MEM
31	7	16.7%	CELL
32	7	16.7%	J MOTOR BEHAV

The results clearly demonstrate that if we regard behaviorism, cognitivism, neuroscience, and psychoanalysis as different approaches to psychology and if we accept the journals identified by Robins, Gosling, and Craik (1999) as core information sources associated with each of those views, then those views overwhelmingly determine the use of information sources and thus what is called "information needs" and "relevance" in library and information science.

For most readers this seems perhaps rather commonplace, but in relation to theory and methods for studying information needs and relevance, it proves that an epistemological approach is necessary, and it proves that such "mental models" are historical, cultural, and social products. This represents quite a revolution compared to traditional "cognitive views" in information science.

The highest level of generalization of relevance criteria is provided by the epistemological theories (which more or less influence specific disciplinary approaches) (Table 8).

The implicit relevance criteria in different approaches influence not only the single researcher, but also the organization of the scientific information system and all processes that are going on in this system. This goes deep into the heart of the system. The design and role of the scientific article and the scholarly monograph reflect different epistemological norms as shown by, for example, Bazerman (1988). Epistemological theories may thus be able to provide an explanation for the construction of the scientific information systems as well as of nonscientific systems. With Foskett (1972) and Swanson (1986) as exceptions, this philosophical perspective on relevance has been almost totally ignored in IS (see also Hjørland, 2000a).

One may, of course, ask whether these results are unique for psychology (or for social science or for less mature fields). Clearly, it is much more difficult to identify different approaches or paradigms in say biology or chemistry. My answer is that relevance and information needs are always determined by theoretical issues, but that some fields may share a high degree of consensus about fundamental theories and findings. It is still not a psychological, cognitive issue to determine the degree of consensus in a field, but

TABLE 7. Most cited sources in core psychoanalytic journals.

About schizophrenia				1999 (Record record 1–278 of 419)			
DIALOG RANK Results				DIALOGRANKResults			
RANK: S27/1–36 Field: CW = File(s): 7 (Rank fields found in 36 records—361 unique terms) Page 1 of 46				RANK: S31/1–278 Field: CW = File(s): 7 (Rank fields found in 251 records—2,004 unique terms) Page 1 of 251			
RANK	No.	Items	Term	RANK	No.	Items	% Ranked Term
1	15	41.7%	INT J PSYCHOANAL	1	98	39.0%	STANDARD EDITION
2	12	33.3%	PSYCHOANAL STUDY CHI	2	96	38.2%	INT J PSYCHOANAL [Core Psychoanalytic Journal]
3	11	30.6%	J AM PSYCHOANAL ASS	3	72	28.7%	J AM PSYCHOANAL ASS [Core Psychoanalytic Journal]
4	10	27.8%	STANDARD EDITION	4	58	23.1%	PSYCHOANAL QUART [Core Psychoanalytic Journal]
5	9	25.0%	PSYCHOTHERAPY SCHIZO'	5	37	14.7%	CONTEMP PSYCHOANAL [Core Psychoanalytic Journal]
6	9	25.0%	SE [Standard Edition. Sigmund Freud]	6	29	11.6%	PSYCHOANALYTIC DIALO
7	7	19.4%	COLLECTED PAPERS SCH	7	22	08.8%	
8	6	16.7%	AM J PSYCHIAT				
9	6	16.7%	PSYCHOANALYTIC CONCE	9	19	07.6%	PSYCHOANAL INQ
10	6	16.7%	PSYCHOANALYTIC STUDY	10	17	06.8%	INT REV PSYCHO ANAL
11	5	13.9%	ARCH GEN PSYCHIAT	11	17	06.8%	PSYCHOANALYTIC STUDY
12	5	13.9%	DEMENTIA PRAECOX GRO	12	16	06.4%	PSYCHOANAL DIALOGUES
13	5	13.9%	ESSAYS EGO PSYCHOLOG	13	16	06.4%	PSYCHOANALYTIC Q
14	5	13.9%	J NERV MENT DIS	14	15	06.0%	INT REV PSYCHOANALYS
15	5	13.9%	OBJECT RELATIONS THE	15	14	05.6%	INT REV PSYCHOANAL
16	5	13.9%	PSYCHOTHERAPY PSYCHO	16	14	05.6%	LEARNING EXPERIENCE
17	5	13.9%	SCHIZOPHRENIA NEED F	17	14	05.6%	PSYCHOANAL PSYCHOL
18	5	13.9%	SCHIZOPHRENIC DISORD	18	13	05.2%	PLAYING REALITY
19	4	11.1%	INT J PSYCHO ANAL	19	12	04.8%	INTERPERSONAL WORLD
20	4	11.1%	LEARNING EXPERIENCE	20	12	04.8%	PSYCHOANAL REV
21	4	11.1%	PSYCHIATRY	21	11	04.4%	AM J PSYCHIAT
22	4	11.1%	PSYCHOANALYTIC READE	22	11	04.4%	COMPLETE LETT S FREU
23	4	11.1%	PSYCHOTIC CONFLICT R	23	11	04.4%	MIND CONFLICT
24	4	11.1%	SCHIZOPHRENIA BULL	24	11	04.4%	PAPERS PSYCHOANALYSI
25	4	11.1%	SCHIZOPHRENIA FAMILY	25	11	04.4%	PSYCHOANALYTIC THEOR
26	4	11.1%	SCHIZOPHRENIA TREATM	26	10	04.0%	ANALYSIS SELF
27	4	11.1%	TREATMENT SCHIZOPHRE	27	10	04.0%	TRANSFERENCE COUNTER
28	3	08.3%	ARCH GEN PSYCHIATRY	28	9	03.6%	AM J PSYCHOANAL
29	3	08.3%	CHRONIC SCHIZOPHRENI	29	9	03.6%	AM PSYCHOL
30	3	08.3%	EGO PSYCHOLOGY PROBL	30	9	03.6%	B MENNINGER CLIN

rather a philosophical one. The degree of relevance agreement among individuals of a given source should be higher among qualified people in fields in which documents play a well-defined role in connection with human activity based on a well-defined theory (e.g., Newtonian mechanics). By contrast, agreement should be low in communities and activities in which both theories and documents are vague and multifarious.

Conclusion

An essentiel problem in IS is how people interpret the texts to be organized and searched as well as the information needs that should be satisfied. Some people might call this *the cognitive perspective*. However, such theories of interpretation are not individual, ahistorical theories, but are epistemologies and ideas that are historically, culturally, socially, and scientifically developed. The cognitive view tends to psychologize the epistemological issues (to study knowledge by studying the individual), but what is needed is the socio-cognitive view, which tends to epistemologize psychological issues (to see individual knowledge in a historical, cultural, and social perspective).

No epistemology or theory of interpretation can replace subject knowledge of, for example, the texts to be indexed. However, epistemological knowledge form an interdisciplinary foundation for general theories about knowledge organization, information retrieval, and other basic issues in IS. *This may be the only general foundation that it is possible to establish!*

If this analysis is correct, epistemology and science studies become the most important field related to information science.

I have now answered the question: what categories and concepts are fundamentally at play in IR. My answer was that it is the epistemological theories and concepts. To the extend that these can be defined rigorously, we can formulate precise criteria for knowledge organization, information

TABLE 8. Simplified relevance criteria in four epistemological schools.

Empiricism	Rationalism	Historicism	Pragmatism
Relevant: Observations, sense-data. Induction from collections of observational data. Intersubjectively controlled data.	*Relevant:* Pure thinking, logic, mathematical models, computer modeling, systems of axioms, definitions, and theorems.	*Relevant:* Background knowledge about preunderstanding, theories, conceptions, contexts, historical developments, and evolutionary perspectives.	*Relevant:* Information about goals and values and consequences both involving the researcher and the object of research (subject and object).
Nonrelevant: Speculations, knowledge transmitted from authorities. "Book knowledge" ("reading nature, not books"). Data about the observers' assumptions and preunderstanding.	*Low priority* is given to empirical data because such data must be organized in accordance with principles that cannot come from experience.	*Low priority* is given to decontextualized data of which the meanings cannot be interpreted. Intersubjectively controlled data are often seen as trivia.	*Low priority* (or outright suspicion) is given to claimed value free or neutral information. For example, feminist epistemology is suspicious about the neutrality of information produced in a male dominated society.

retrieval, and the design of information systems. If this turns out to be a hard job, it should not be given up unless other ways forward can be demonstrated to perform a better job.

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References

Andersen, H. (1999). Political attitudes and cognitive convictions among Danish social science researchers. Scientometrics, 46(1), 87–108.

Bateson, G., Jackson, D.D., Haley, J., & Weakland, J.H. (1963). A note on the double bind: 1962. Family Process, 2(1), 154–161.

Bazerman, C. (1988). Shaping written knowledge: The genre and activity of the experimental article in science. Madison, WI: Univertsity of Wisconsin Press. [Also available as pdf file on the Internet: http://aw.colostate.edu/books/bazerman_shaping/main.htm].

Bhargava, R. (1998). Holism and individualism in history and social science. Routledge Encyclopedia of Philosophy (version 1.0). London: Routledge.

Bogdan, R.J. (1994). Grounds for cognition. How goal-guided behavior shapes the mind. Hillsdale, NJ: Lawrence Earlbaum Associates.

Brooks, T.A: (1995). Topical subject expertise and the semantic distance model of relevance assessment. Journal of Documentation, 51(4), 370–387.

Capurro, R. (1985). Epistemology and information science. Lecture given at the Royal Institute of Technology Library Stockholm, Sweden. REPORT TRITA-LIB-6023. Also available on: http://www.capurro.de/trita.htm#III. Hermeneutics and Information. (Visited August 1, 2001).

Cohen, J. (1994). Some steps towards a general theory of relevance. Synthese, 101, 171–185.

Cooke, N.J. (1994). Varieties of knowledge elicitation techniques. International Journal of Human-Computer Studies, 41(6), 801–849.

Danziger, K. (1990). Constructing the subject. Historical origins of psychological research. Cambridge: Cambridge University Press.

Danziger, K. (1997). Naming the mind. How psychology found its language. London: Sage.

Foskett, D.J. (1972): A note on the concept of relevance. Information Storage and Retrieval, 8, 77–78.

de May, M. (1977). The cognitive viewpoint: Its development and its scope. CC 77: International Workshop on the Cognitive Viewpoint. Gent, Gent University, pp. xiv–xxxii.(Quotation pp. xiv–xvii).

Frohmann, B. (1990). Rules of indexing: A critique of mentalism in information retrieval theory. Journal of Documentation, 46(2), 81–101.

Gärdenfors, P. (1999). Cognitive science: From computers to anthills as models of human thought. Human IT, 3(2). http://www.hb.se/bhs/ith/2-99/pg.htm.

Gardner, H. (1985). The mind's new science; A history of the cognitive revolution. New York: Basic Books.

Hjørland, B. (1991). Det kognitive paradigme i biblioteks—Og informationsvidenskaben [The cognitive paradigm in Library and Information Science]. Biblioteksarbejde, 33, 5–37.

Hjørland, B. (1993a). Emnerepræsentation og informationssøgning. Bidrag til en teori på kundskabsteoretisk grundlag. [Subject representation and information seeking. Contributions based on theory of knowledge] Göteborg: Valfrid.

Hjørland, B. (1993b). Toward a new horizon in information science (I.S.): Domain-analysis. Oral presentation given at ASIS 56's Annual Meeting in Columbus, Ohio, October 25. 1993. Available as sound-casette F248-4. (Abstracts published on page 290 in: ASIS '93. Proceedings of the 56th ASIS Annual Meeting, 1993, Vol. 30. Medford, NJ: Americal Society for Information Science & Learned Information, Inc.).

Hjørland, B. (1997). Information seeking and subject representation. An activity-theoretical approach to information science. Westport, CT: Greenwood Press.

Hjørland, B. (1998b). The classification of psychology: A case study in the classification of a knowledge field. Knowledge Organization, 24(4), 162–201.

Hjørland, B. (2000a). Relevance research: The missing perspectives: "Nonrelevance" and "epistemological relevance." Journal of the American Society for Information Science, 51(2), 209–211.

Hjørland, B. (2000b). Review of Wallerstein (1996). Open the social sciences, report of the Gulbenkian Commission on the Restructuring of the Social Sciences. Stanford, CA: Stanford University Press. I: Knowledge Organization, 27(4), 238–241.

Hjørland, B. (2002). Domain analysis in information science: Eleven approaches. Paper submitted to Journal of Documentation October 2001.

Hjørland, B., & Albrechtsen, H. (1995). Toward a new horizon in information science: Domain analysis. Journal of the American Society for Information Science, 46(6), 400–425.

Jacob, E.K., & Shaw, D. (1998). Socio-cognitive perspectives on representation. In M.E. Williams (Ed.), Annual Review of Information Science and Technology (vol. 33, pp. 131–185). Medford, NJ: Information Today for American Society for Information Science.

Karpatschof, B. (2000). Human activity. Contributions to the anthropological sciences from a perspective of activity theory. Copenhagen: Dansk Psykologisk Forlag. ISBN: 87 7706 311 2.

Kuhn, T.S. (1962, 1970). The structure of scientific revolutions. Chicago, IL: University of Chicago Press.

Lakemeyer, G. (1997). Relevance from an epistemic perspective. Artificial Intelligence, 97, 137–167.
Lindsay, P.H., & Norman, D.A. (1977). Human information processing. An introduction to psychology (2nd ed.). San Diego: Harcourt Brace Jovanovich.
Lykke Nielsen, M. (2000a). Domain analysis, an important part of thesaurus construction. ASIS SIG Classification Research Workshop. Classification for User Support and Learning Sheraton Chicago Hotel & Towers Chicago, IL Sunday, Nov. 12, 2000. pdf-file: http://uma.infoscience.uiowa.edu/sigcr/papers/sigcr00lykke.pdf (Visited 2001-09-18).
Lykke Nielsen, M. (2000b). Domain analysis, an important part of thesaurus construction. ASIS SIG Classification Research Workshop. Classification for User Support and Learning Sheraton Chicago Hotel & Towers Chicago, IL Sunday, Nov. 12, 2000. Powerpoint presentation http://bx.db.dk/mln/powerpoint/domain.ppt (Visited 2001-09-18).
Neighbors, J.M. (1980). Software construction using components. Technical Report 160, Department of Information and Computer Sciences, University of California, Irvine.
Norman, D., & Rumelhard, D. (1975). Explorations in cognition. San Francisco: Freeman.
Ørom, A. (2000). Information science, historical changes and social aspects: A Nordic outlook. Journal of Documentation, 56(1), 12–26.
Pao, M.L. (1993). Term and citation retrieval: A field study. Information Processing and Management, 29(1), 95–112.
Pao, M.L., & Worthen, D.B. (1989). Retrieval effectiveness by semantic and pragmatic relevance. Journal of the American Society for Information Science, 40(4), 226–235.
Robins, R.W; Gosling, S.D., & Craik, K.H. (1999). An empirical analysis of trends in psychology. American Psychologist, 54(2), 117–128.
Segal, G. (1998). Methodological individualism. Routledge encyclopedia of philosophy (version 1.0). London: Routledge.
Swanson, D.R. (1986). Subjective versus objective relevance in bibliographic retrieval systems. Library Quarterly, 56(4), 389–398.
Taylor, R.S. (1968). Question–negotiation and information seeking in libraries. College and Research Libraries, 29, 178–194.
Timpka, T. (1995). Situated clinical cognition. Artificial Intelligence in Medicine, 7, 387–394.
Tolman, E.C. (1932). Purposive behavior in animals and men. New York: The Century Co.
Törnebohm, H. (1974). Paradigm i vetenskapernas värld och i vetenskapsteorin. Göteborg, Sweden: University of Göteborg.
Tuominen, K. (2001). Tiedon muodostus ja virtuaalikirjaston rakentaminen: Konstruktionistinen analyysi (with an English summary). Acta Electronica Universitatis Tamperensis 113. ISBN 951-44-5112-0. ISSN 145-594X. http://acta.uta.fi/english/teos.phtml?5179.
Wagner, P., & Wittrock, B. (1991). States, institutions and discourses: A comparative perspective on the structuration of the social sciences. In P. Wagner, B. Wittrock, & R. Whitley (Eds.), Discourses on society. The shaping of the social science disciplines (pp. 331–355). Dordrecht: Kluwer Academic Publishers.
Watson, J.B. (1913). Psychology as the behaviorist views it. Psychological Review, 20, 158–177.
Winograd, T. & Flores, F. (1986). Understanding computers and cognition. A new foundation for design. Reading, MA: Addison-Wesley Publishing Comp.
Woodworth, R.S. (1939). Psychological issues: Selected papers of Robert S. Woodworth. New York: Columbia University Press.

APPENDIX 1: Search strategies used to rank the most cited sources in four psychological paradigms: (The neuroscientific journals are more comprehensively covered by the *Science Citation Index*. For this purpose, only the *Social Sciences Citation Index* has been used.).

File 7: Social SciSearch(R) 1972–2001

S1	2094	JN = "JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVI"
S2	1808	JN = "JOURNAL OF APPLIED BEHAVIOR ANALYSIS"
S3	4107	JN = "BEHAVIOUR RESEARCH AND THERAPY"
S5	2099	JN = "BEHAVIOR THERAPY"
S6	561	JN = "COGNITIVE PSYCHOLOGY"
S7	1094	JN = "COGNITION"
S8	2276	JN = "MEMORY & COGNITION"
S9	1624	JN = "JOURNAL OF EXPERIMENTAL PSYCHOLOGY-LEARNING ME"
S10	957	JN = "JOURNAL OF NEUROPHYSIOLOGY"
S11	1499	JN = "JOURNAL OF NEUROSCIENCE"
S12	50	JN = "ANNUAL REVIEW OF NEUROSCIENCE"
S13	492	JN = "TRENDS IN NEUROSCIENCES"
S14	2463	JN = "INTERNATIONAL JOURNAL OF PSYCHO-ANALYSIS"
S15	267	JN = "INTERNATIONAL JOURNAL OF PSYCHOANALYSIS"
S16	2197	JN = "PSYCHOANALYTIC QUARTERLY"
S17	2342	JN = "JOURNAL OF THE AMERICAN PSYCHOANALYTIC ASSOCIA"
S18	1318	JN = "CONTEMPORARY PSYCHOANALYSIS"
S19	10108	S1 OR S2 OR S3 OR S5
S20	5555	S6 OR S7 OR S8 OR S9
S21	2998	S10 OR S11 OR S12 OR S13
S22	8587	S14 OR S15 OR S16 OR S17 OR S18
S23	18827	SCHIZOPHRENIA?/TI
S24	52	S19 AND S23 [Schizophrenia/ti and behavioristic journals]
S25	2	S20 AND S23 [Schizophrenia/ti and cognitivistic journals]
S26	41	S21 AND S23 [Schizophrenia/ti and neuroscientific journals]
S27	36	S22 AND S23 [Schizophrenia/ti and psychoanalytic journals]
S28	302	S19 AND PY = 1999 [Behavioral journals 1999]
S29	278	S20 AND PY = 1999 [Cognitive journals 1999]
S30	42	S21 AND PY = 1999 [Neuroscientific journals in SSCI 1999]
S31	419	S27 AND PY = 1999 [Psychoanalytic journals in 1999]