Interaction with Texts: Information Retrieval as Information-Seeking Behavior

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Abstract

We present an analysis of information retrieval as an information-seeking activity, supporting people's inteactions with text. This analysis suggests that some assumptions underlying the standard model of information retrieval are inappropriate, and we suggest alternative assumptions and discuss their implications for information retrieval system design. It is proposed that information retrieval is most properly considered as information-seeking behavior, that the central process of information retrieval is user interaction with text, and that the user is the central component of the information retrieval system. Possible ways to incorporate this view in the design of information retrieval systems are discussed.

1. Introduction

From our experience of the everyday world, we see that people are in consistent, if not constant interaction with texts[1] of a variety of types, for a variety of purposes. We read newspapers, we watch television, we go to picture galleries, we use libraries, we engage with advisory services; in order to know about our world, to be entertained, to understand, to learn, to become informed, to do our work, to help us solve our problems. An essential feature of all of these activities is precisely our *interaction* with these texts. By interaction, we mean that, in such activities, people are not just passive recipients of messages, but rather active seekers of texts, and active constructors of meaning from these texts. They look for texts of potential interest, they make judgments about the usefulness or interest of texts by engaging with them, they interpret texts in order to understand them. Thus, our engagement with texts and our interpretations of them are central to our being able to use them for our goals, whatever they may be.

At times, we engage in behaviors stimulated by our desire to manage a problem (Belkin, Seeger & Wersig, 1983), resolve a problematic situation (Schutz & Luckmann, 1973; Wersig, 1979), respond to a gap in our life-path (Dervin, 1983), or resolve an 'anomalous state of knowledge' (Belkin, 1980). Such activities are usually characterized as *information-seeking behaviors,* in which we actively engage with texts, or collections of texts, or people who give us access to texts, in order to find and

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[1]Text in this paper is to be taken in the semiotic sense of an ordered collection of signs, which includes information-bearing objects in any mode or medium.

be able to use information which can help us in problem management, etc. There is clearly a wide variety of such information seeking behaviors, such as asking a colleague for advice, browsing through journals to keep up-to-date, searching in a library for some specific information, and so on. It is important to note that, despite this range of forms that information-seeking behaviors take, they are all interactions with texts, and all share the general characteristics of such interactions, described in the previous paragraph.[2]

In the situations which lead to information-seeking behaviors, our interactions with texts often take place within the context of systems, social and technical, which are constructed to support us in accomplishing the goals of the behaviors. Such systems include, for instance, libraries, information centers, advisory services, and information retrieval (IR) systems. In this paper, we are concerned explicitly with the issue of how one might best characterize the IR problem, and IR systems, in order to support people in their information-seeking behaviors most effectively.

2. 'Standard' Information Retrieval

Information retrieval (IR) has most usually been construed as the problem of selecting texts from a database in response to some more-or-less well-specified query. From this point of view, the major issues of concern to IR have been the representation of texts, and of queries, and techniques for the comparison of text and query representation. This 'standard' view of IR is perhaps most succinctly represented in the diagram of Figure 1.

From Figure 1, we see that the standard view of IR has *comparison* of text surrogate and query as its central process. This comparison in turn depends upon the two *representation* processes. In practice, most emphasis has been placed upon the process of text representation, with relatively little work having been done on the development of representation schemes specific to information needs or problems. Concern with representation of the information need has typically arisen after the process of *judgment,* which is typically to be performed by the user, as an estimate of the potential relevance of the text to the information need. The results of the judgement process are then used by the system to modify the query, or, occasionally to modify the text representations. This process of query modification, or 'relevance feedback', is perceived, in the standard view of IR, as an attempt to gain the 'best' possible representation of the user's query, or 'information need', in order to select the texts most likely to be relevant to that query ; that is, to improve the representation so that the comparison process will work most effectively. It is important to recognize that, in this model of IR, the person involved in IR is seen as a user of the system, standing outside of it. Involvement of the user with the IR system is minimal, and interaction (in the form of the judgment process) is seen as ancillary to, and only in support of, the representation and comparison processes.

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[2]In those information-seeking behaviors where there is direct interaction with another person, as in advisory situations, we can consider the dialogue itself, including the advice, as a text
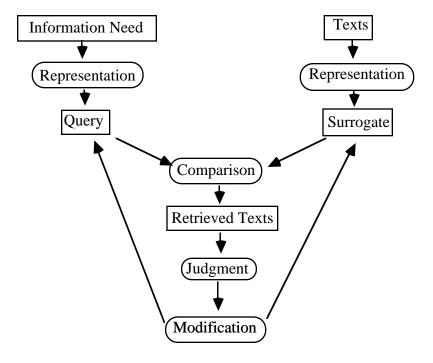
Figure 1. A model of the standard view of information retrieval

Underlying this view of IR are two strong assumptions. The first is that there exists some static information need associated with the user, which is, at least in principle, specifiable. The second is that the most appropriate way to address that need is to search for, and select, the text or texts which can best resolve that need. The force of these assumptions is, as we see from the discussion of the standard view, to devalue or even ignore the significance of interaction of the 'user' with the texts; and, to provide support for only one form of information-seeking behavior, that associated with searching for some well-specified information item. Additionally, through the privi-leged position of comparison and representation, and the assignment of responsibility for these activities to the system, the standard view of IR leads to strong control by the system of the entire IR process, and the consequent lack of power or control by the user.

There is a long history of research and practice in IR within this 'paradigm'. Indeed, one is tempted to say that almost all IR research and practice has been based on these assumptions, or this general viewpoint. There have been, however, some notable ex-ceptions taken to this approach to IR, which, in addition to their intrinsic worth, are of interest in terms of what they have recognized as problematic in the standard model,

and how they have addressed these problems.

For instance, Oddy's (1977) system THOMAS was a response to the assumptions of a static, specifiable information need. THOMAS's goal was to allow users of the system to engage in information seeking without query specification. It is of some interest in this context to note that this goal was accomplished by making the user's interaction (especially judgment) with the texts the central process of the system. The user's conception of her/his information need was assumed to be dynamic, and the means of resolving it was through a browsing-like information-seeking behavior. Croft & Thompson (1987) incorporated support for two different information-seeking behaviors within their system, I^{3}R, namely, browsing and search by specification. Additionally, I^{3}R encouraged the user to participate actively in the system, by eliciting and incorporating the user's knowledge in the representation processes. Bates (1989) has suggested an IR system design based on a concept of information needs which change as a person interacts with texts in an information-seeking episode. She has also proposed a model, in Bates (1990), in which control of the IR process can be varied between the system and the user. In both of these papers, and in others, Bates has argued forcefully, eloquently and persuasively against the assumptions underlying the standard view of IR. Ingwersen (1992) has suggested a design model for IR systems in which the user's interaction with the components of the system, and interaction among those components, is central. In this model, the IR system is construed as an intermediary, whose functioning is dependent upon interaction with the user, and in particular on knowledge about the user's interactions with the texts. This is, in essence, a dialogue-based model of IR.

These examples of attempts to respond to the constraints of the assumptions of the standard model of IR demonstrate that the constraints are indeed real, with real, and unfortunate consequences. They, and others like them, also demonstrate that it is possible to address at least some of the problems raised by these assumptions, and suggest both general strategies and specific techniques for the development of a more general model of IR. From this work, we see that, while not wholly incorrect, the assumptions underlying the standard view of IR are untenable as general principles, and constrain IR unrealistically to support of only one kind of information-seeking behavior.

Building upon the work summarized above, this paper attempts to establish an alternative view of IR. The basis of the alternative approach which is presented here will be to embed IR within the general context of human interaction with texts, specifically referring to information-seeking behaviors. We will attempt, in particular, to develop a view of IR in which the user is the central component in the system, and interaction is the central process. Such a model of IR would not reject the work which has been done in the standard paradigm, but rather incorporate it as support for particular classes of interaction, and information-seeking behaviors.

3. Information Retrieval as Information-Seeking Behavior

We begin by considering the assumptions about the IR situation of the standard model, in what sense they have failed, and why. The assumption of a static, specifiable information need is problematic from the point of view of interaction with texts, because

such interaction necessarily implies interpretation, and interpretation necessarily implies change in the interpreter. If the information-seeker's knowledge changes by virtue of engagement with text, then it is at least possible, if not necessary, that that person's view of the situation or condition that led to engagement in information-seeking behavior also changes. Considering this from the point of view of Schutz and Luckmann (1973), any modification of one's knowledge, in the condition of a problematic situation, is itself a modification of the problematic situation. Or, a change in one's state of knowledge, by virtue of having engaged with a text, will be reflected in some change in the anomalous state of knowledge (Belkin, 1980) that led one to engage in information-seeking behavior. All this implies that the assumption of a single information need, constant (although progressively better represented) through the course of an information-seeking episode, is inadequate to the information-seeking situation in general.

There is by now a substantial literature, from both theoretical and empirical perspectives, on the non-specifiability of information 'needs' (e.g. Bates, 1989; Belkin, Oddy & Brooks, 1982; Belkin, Seeger & Wersig, 1983; Oddy, 1977; Taylor, 1968). Most such arguments depend upon concepts concerning the cognitive state of the person engaging in information-seeking behavior, but aspects of this issue can also be addressed from the point of view of interaction with texts (e.g. Bates, 1989). The argument follows from the dynamic nature of the problematic situation, and, in particular, from the unpredictability of the result of the interpretation of a text, from the point of view of the IR system; and, the unpredictability of what texts will be offered, and what they will offer, from the point of view of the information seeker. Thus, interaction with texts implies at least the possibility of an unpredictable, and therefore unspecifiable, change in the condition which led to the interaction in the first place (e.g. the information 'need').

The second assumption of standard IR, that of a single form of information-seeking behavior, is clearly inadequate. There is substantial documentation, empirical and theoretical, of a variety of information-seeking behaviors in which people engage. Belkin, et al. (1990), Ellis (1989), Hancock-Beaulieu (1990)and Kuhlthau (1991) all have demonstrated that, in the course of information-seeking episodes, people change from one kind of interaction to another, and in the course of problem resolution, people engage in different types of interactions with texts, according to different goals, knowledge, intentions, and so on. These different goals, such as, for instance, learning about the structure of some group of texts, lead to behaviors which cannot be supported effectively through the specification of a query and the retrieval of a relevant text. Thus, an IR system or model which depends solely upon representation and comparison of well-specified queries with texts cannot support behaviors suited to such goals, such as, for instance, browsing. Both I^3R (Croft & Thompson, 1987) and THOMAS (Oddy, 1977), as well as hypertext systems such as that described by Frisse (1988), demonstrate that the support of browsing-like information-seeking requires active intervention and interaction by the user with the texts, and the representations of texts and their relationships, which the standard model of IR cannot support. The usual response has been to build parallel systems to support different information-seeking behaviors; another, which we support here, is to begin from a model of IR in which the range of information-seeking behaviors can be integrated.

Our alternative assumptions to those of standard IR, derived from the concept of information-seeking behavior as human interaction with texts, are thus the following:

1. That information-seeking is inherently an interactive process, and that that process is characterized by the general features of people's interactions with texts;

2. That the goal of IR systems is to support the range of information-seeking behaviors.

From these assumptions, it follows that the central process for IR is interaction of user with text, in support of a wide variety of information-seeking behaviors and associated goals, relevant to a different problematic situations. It also follows that the information seeking is the central component of IR, since it is that person's interaction with texts which drives the entire IR system. This, in turn, means that an adequate model of IR, under these assumptions, requires that the user be an active participant in the IR system, rather than a passive recipient of and reactor to output from the system. In short, these conditions suggest that it is appropriate to model that which the user does in the course of interaction in an IR system, as information-seeking behavior. In this way, the processes in which the person engages, the entities with which the person interacts, and the salient characteristics of the person engaged in information-seeking can be identified and treated in an integrated manner, responsive to the variety of goals and conditions of interaction.

4. Implementing Information Retrieval as Information-Seeking Behavior

It is now reasonable to ask what a model of IR based on our alternative assumptions might look like, or even, how one could begin to implement such ideas in IR systems. Unfortunately, we cannot offer here definitive answers to these questions, as, for instance, in terms of a formal alternative model of IR. These are still goals subject to further research. Instead, we discuss some suggestions for potential ways to take account of this viewpoint, and how these could be (or, in some cases, have been) realized in IR system design. In particular, we consider:
*   how to incorporate the user as the central component of the IR system;
*   how to identify and support different information-seeking behaviors and different information-seeking goals; and,
*   how to make user interaction with texts the central process of IR.

4.1 Incorporating the User in the IR System

Incorporating the user in the IR system has been a major component of several different models of IR. Belkin, Oddy & Brooks (1982), for instance, suggested that the user should be a part of the IR system, in order for the rest of the system to be able to understand, and take account of, the situation that led the user to engage in the system, and in order to take advantage of the user's response to texts offered for interaction. Their means for accomplishing this was two-fold. First, they made representation of the person's anomalous state of knowledge the primary process in the system. This

included incorporating in the representation some aspects of the person's goals and situation in general. Second, their system design required the user to interact with offered texts, and to inform the rest of the system of the results of the interpretation, with specific reference to whether, and in what ways, the text was useful.

Belkin, Seeger & Wersig (1983) took a somewhat different approach to incorporation of the user in the IR system, pointing out that for an IR system to be effective in supporting a person in problem management, it is necessary for the built part of the system (the 'information provision mechanism - IPM) to play the role of an intelligent 'intermediary' between the user and the texts with which the user would interact. In this model, the primary effort of the IPM is to understand the characteristics of the user, and the user's problematic situation, which would be relevant for identifying texts which might be appropriate for the user to interact with. This understanding was itself to be gained through dialogue-like interaction with the user, based on the functions taking place in equivalent human-human information interactions. Ingwersen (1992) takes this approach several steps further, stressing more explicitly the intermediary role, and identifying a number of new functionalities which support the user in interaction with texts, and the rest of the system in identifying appropriate texts.

Bates (1990) has shown that control is a crucial issue in IR interaction, pointing out that under the standard model the IR system assumes almost total control of the interaction, by doing the representation, comparison and modification automatically, and without reference to the user. She suggests that, although there may be situations in which the user would like to surrender control in this way, there are other situations, defined, for instance, by the nature of the information-seeker's goals, or preferences for interaction style, in which the user would prefer to more directly control the course of the interaction, through, for instance, direct interaction with texts, direct choice of which texts to interact with, and so on. This leads to a concept of degree of control associated with particular kinds of interaction, and suggestions as to how to implement a system with mixed control. Who is in control is of course dependent on the roles and responsibilities of the participants to the interaction.

Overall, then, these various approaches to incorporating the user in the IR system suggest that treating IR as an interaction between user and intermediary (or advisor), in which both parties have responsiblities, and over which both parties can exercise control, is a reasonable strategy for making the user the central component of IR.

4.2 Identifying and Supporting Information-Seeking Behaviors

The problems of identifying and supporting different information-seeking behaviors have been addressed by a number of researchers, including Ellis (1989) and Hancock-Beaulieu (1990). Here, we discuss our own approach to this issue, as used in the design of two different IR systems. Belkin, Marchetti & Cool (1993) have suggested that information-seeking behaviors (or, in their terms, information-seeking strategies - ISSs) can be characterized according to some small set of dimensions or facets which define a space of ISSs. Figure 2 is a summary of the four facets which they tentatively

suggest are at least necessary to account for the range of ISSs which have been observed. These facets, *goal* of the interaction, *method* of interaction, *mode* of retrieval and *type of resource* interacted with, have been identified through observation and classification of information-seeking behaviors in a variety of settings. Their suggestion is that any ISS can be characterized according to its values on these facets, or dimensions. Thus, the explicit combination of poles of each facet, in Figure 2, leads to a set of 16 prototypical ISSs.

ISS	METHOD		GOAL		MODE		RESOURCE	
	Sc	S	L	S	R	S	I	M
1	x		x		x		x	
2	x		x		x			x
3	x		x			x	x	
4	x		x			x		x
5	x			x	x		x	
6	x			x	x			x
7	x			x		x	x	
8	x			x		x		x
9		x	x		x		x	
10		x	x		x			x
11		x	x			x	x	
12		x	x			x		x
13		x		x	x		x	
14		x		x	x			x
15		x		x		x	x	
16		x		x		x		x

Method: Sc = Scan; S = Search
Goal: L = Learn; S = Select
Mode: R = Recognize; S = Specify
Resource: I = Information; M = Meta-information

Figure 2. Information Seeking Strategies (after Belkin, Marchetti & Cool, 1993)

Belkin, Marchetti & Cool (1993) point out that, in the course of a single information-seeking episode, a person may engage in several such ISSs, moving from one to another as knowledge, goals, intentions, and so on, change, through the course of the interaction. They suggest that, by characterizing ISSs according to their underlying dimensions, both support for the single ISS currently being engaged in, and support for movement from one ISS to another can be specified within a single IR system design. They describe an interface, BRAQUE, which does provide such support, allowing the user to move one ISS to another according to the user's (self-defined) current goals and knowledge, especially in response to the results of interaction within the system.

Belkin & Cool (1993), and Belkin, Cool, Stein & Thiel (1993), starting from the same concept of dimensions of ISSs, suggest further that each region of the ISS space could have associated with it, not only a general information-seeking behavior, but a proto-

typical interaction or dialogue structure, which takes place between the user and the rest of the IR system. They propose, on this basis, an IR system design which provides dialogue patterns for the different ISSs, and sequences of ISSs, based on a library of specific cases of real interactions, organized according to the protoypical ISS structures. This allows for explicit interactive, and mixed-initiative support for specific information-seeking behaviors, seen as complex combinations of ISSs, which change as the user changes in her/his interaction with the texts.

A key problem arising in these approaches to identification and support of information-seeking behavior, is that they are explicitly concerned just with behavior, and have little to say about why a person might engage in one form of information-seeking in any particular situation. In order to be able to provide support other than just offering the user a choice of support mechanisms (for instance, predicting appropriate ISSs in specific circumstances), it is necessary to establish relations between the behaviors and some other characteristics of the user, such as the person's goals or problematic situation. This, in turn, suggests that we need some classification of such factors, and a means to establish how they are affected by other aspects of the situation in which the user is embedded. Dervin (1983), in her classification of 'information gaps' provides one possible approach to this issue. Belkin & Marchetti (1990) have suggested cognitive task analysis as another means for identifying relations between user characteristics and specific information-seeking behaviors. Brajnik , Guida & Tasso (1988), and Daniels (1986) have suggested that the construction of specific kinds of models of the user, by other parts of the system, could be used to establish such relations. And the types of studies discussed in section 4.1 also address this issue, in terms of identifying what it is important to know about the user, in order to support the user in interaction in the IR system. But it must be said that, at the moment, no-one has succeeded in firmly establishing such relations, and that this issue is definitely still a matter for further research.

4.3 Interaction with Text as the Central Process of IR

The discussion in the previous two sections rather clearly suggests how one might also make the user's interaction with texts the central process in IR. Thinking about participation roles and responsibilites in the interaction, or at least making mixed control possible, as suggested by Bates (1990), is a clear starting point. Promoting and supporting direct access to texts, and direct manipulation of texts, and direct response to texts, whether guided, as in Oddy's (1977) THOMAS, or user-directed, as in Belkin, Marchetti & Cool's (1993) BRAQUE, is another. Promoting movement among information-seeking behaviors, as for instance, by the dialogue structures suggested by Belkin, Cool, Stein & Thiel (1993), or supporting such movement by providing tools for it, as in BRAQUE, also serves to make the user's interaction central. The facilities in I^{3}R (Croft & Thompson, 1987) for supporting browsing, and especially for eliciting and using the user's knowledge in support of the overall interaction, also are means to address this goal.

These are all examples of how to move the concept of the person's interaction with texts, including all of the interpretation issues, to the fore. They have in common that

representation and comparison processes, although clearly necessary, are used to support the user's interaction. This is in stark contrast to the standard model of IR, in which interaction, in the form of the judgement process, is construed as support for representation and comparison. Thus, making user interaction with text the central process of IR seems to require allowing user control of the overall interaction, basing representation upon the results of user interpretation of the interaction, and using the comparison process to support interaction, by suggestion, rather than as a means to a definitive answer.

5. Conclusion

From our analysis of the conditions which lead to the IR situation, we conclude that IR is most properly considered as a form of information-seeking behavior, in which the user's interaction with text is the central phenomenon, to which the IR system must respond, and which the IR system must support. The explict consequences of this view are that: the goal of the IR system is to support the user in her/his entire range of information-seeking behaviors; the user must be considered the central component of the IR system; and, interaction (both user's interaction with texts, and other interactions which support it) is the central process of IR. From this follows, that the role of the representation and comparison processes in IR are in support of interaction, and, that control of the IR interaction must be mixed between the participants.

Although we do not present a model of IR based on these conclusions, we have shown, by way of example, how various aspects of their consequences can be applied to IR models, and especially, to the design of IR systems. Taken together, the various approaches to the different problems raised by this view of IR do suggest a general strategy for IR system design which might eventually evolve into a more formal model. This strategy begins by considering the IR system as an explicitly interactive system, among the user, the textual resources, and a mediating mechanism. The structure of this interaction is dialogue based, with mixed initiative. Each participant in the system has explict roles and responsibilities. The mediating mechanism and textual resource provide suppport for the user to engage in several information-seeking behaviors, with movement among the behaviors available both on user instigation and system guidance. The results of the user's interaction with the texts can be used directly by the person for modifying the interaction, and by the mediating mechanism, to provide suggestions for guiding the interaction. The texts of the system are available for direct engagement by the user, and direct manipulation by the user, as well as for comparison processes engaged in by the mediating mechanism.

In general, this strategy aims to empower the user in the information-seeking interaction, by establishing the user's goals and interactions with text as primary, and the rest of the IR system components as supportive of them. We hope that IR systems designed on these principles would be systems which would be not only effective, but also pleasurable, in helping people to interact with text.

Acknowledgement

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