Information as a User Construct: The Relevance of Perceived Information Needs to Synthesis and Interpretation

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There are two interlocking foci that guide this entire set of papers. One is on a problem — the low application by practitioners of research and development literatures in the practice of education. The other is on a posited set of strategies for dealing with the problem — synthesis and interpretation.

The problem — underutilization of literature — is said to result from a number of interacting factors. Frequently, blame is placed on the practitioner who is said to have, for example, too little time to use information bases and too little skill in using them. More often, however, it is acknowledged that the sheer volume of information available is a major deterrent. In this context, it is acknowledged that something must be done by information systems to synthesize and interpret the results of research and development efforts so they are more coherent and, thus, more useful for application to practice.

Synthesis and interpretation, then, are the selected strategies of interest. While definitions of synthesis and interpretation are many and frequently overlapping, it is generally assumed that taken together the two strategies would pull out from the literature “state of the art” generalizations, isolate areas where generalizations cannot be made, and draw conclusions about the implications of the work for practice. In essence, then, the two strategies are posited as a means of filling the gap between research and development results and practice.

In order to implement use of the strategies, there are three important questions which require attention. Two deal with the doing of synthesis and interpretation. One deals with impacts. The first question asks what synthesis and interpretation procedures can be used in a system and is involved in issues ranging from the nature of knowledge to the nature of collective action
and decision making. The second asks what kinds of synthesis and interpretation products can be produced and is concerned with such issues as the nature of classification schemes and the nature of message construction. The third asks what is accomplished by creating synthesis and interpretation products and focuses on such issues as the nature of human information products and focuses on such issues as the nature of human information seeking and message effects. In sum, the three questions focus our attention on the process of synthesizing and interpreting the products resulting from these processes, and the uses of the products.

The Role of This Paper

The focus of this paper is on the relevance of perceived information needs to synthesis and interpretation. Begging for the moment the many difficulties in defining both the terms information and need, we can start, at least, by accepting the idea that the word need implies a state that arises within a person, suggesting some kind of gap that requires filling. When applied to the word information, as in information need, what is suggested is a gap that can be filled by something that the needing person calls "information."

This paper is concerned, then, with all three of the questions raised above but particularly with question 1, on the nature of knowledge, and question 3, concerning the impacts or uses of synthesis and interpretation products. More specifically, the concern is for understanding whether, when, and how synthesis and interpretation products will be used by people with information needs and the impacts of that use. Obvious related concerns are the implications of an understanding of people's information needs for the processes by which synthesis and interpretation products are produced and the nature of the products themselves.

This focus on people's information needs catapults us into the world now commonly called the world of the "user." As Brittain (1970) notes, there is a growing concern for making information systems "user-oriented," a movement away from what he calls "source-controlled" systems to "receiver-controlled" systems in all areas of human service delivery. Despite the obvious intuitive logic of designing a service to meet the needs and styles of the users of the service, the emphasis on users is a relatively new one. Brittain talked about it as a growing movement in 1970; Paisley and Parker started designing user-controlled systems around 1965; the first large-scale study of citizen information needs was done in 1973 (Warner et al.). The reason for the recency of the emphasis will be discussed later in this paper.

The important point here, however, is that the recency of the concern means we have available to us relatively few empirical studies dealing with users, their information needs, and how they fill those needs. Thus, for example, Paisley (1965) attempted to review user studies in the social sciences and quickly concluded there weren't any to review. Five years later, Brittain (1970) found only eighteen studies using empirical methods to look at the use of social science materials and concluded that most of these did little more than make a determination of user demand for specific available documents instead of focusing on information needs and how they are filled. Zweizig (1977) painted essentially the same portrait of the empirical work relating to public librarianship. Dervin (1976a) and Dervin et al. (1976) did extensive reviews of the literature on adult information needs across topic areas and found only a handful of relevant studies. At that time, no one study was found that did anything more than assess document demand by professionals in most of the major professions, including education.

So we face the task of understanding the relevance of information needs to synthesis and interpretation with relatively little empirical evidence to speak to the issue. This state of affairs was bemoaned by Rees and Schultz in 1967 when they compiled a long list of questions for which we need answers ranging from understanding the types of information services most appropriate to different cognitive processes and different tasks to the ways in which services can be most facilitative of work. Brittain (1970) reiterated the concern, as did Dervin (1976a). And, very recently, Donohew et al. (1978) noted that despite a large volume of literature on decision making and information processing we still know very little about the strategies people use to resolve their information needs.

Despite this lack of directly relevant literature, there are a handful of recent studies that have focused on general population adults and their everyday information needs and how they fill them. Beyond this handful, we must rely on the growing body of social science research focusing on human cognitive processes, information processing, mass media use, and interpersonal communication activity.

Taking these literatures and drawing a portrait from them will provide us with two outcomes. The first is expected — a catalogue of generalizations which have consensual backing. Yet, as will be seen below, the consensual portrait which emerges is both alarming and disappointing. It suggests that people — even professionals — just don't bother using information or at least, do not use it in the forms currently available. Beyond this disappointing por-
trait, however, is a far more useful outcome to be gained from a pass through the relevant literatures. That outcome exists several abstraction levels up from actuarial evidence and deals with the conceptual frameworks which have been applied by researchers in studying information-related human behavior.

What is important about this outcome is that it suggests that the reason for the dismal portrait of the potential for information services that comes from the literature is not that people are, indeed, disinterested in information but, rather, that systems and researchers have been looking at something they call information rather than something users call information. This distinction is what much of this paper will be about, and a more detailed description of it will be presented later.

In the context of the above, then, the purpose of this paper is to offer a synthesis and interpretation of the relevant social science literature dealing with people, their information needs, how they fill those needs, and the effects gained from doing so. While this paper will draw on actuarial evidence, it will put more emphasis on conceptual issues, for it is an assumption of this paper that it is within this focus that the major important contributions for our task of understanding the relevance of information needs to synthesis and interpretation will emerge.5

Two Conflicting Portraits of People and Information

It is important to begin with a portrait of people, their information needs, and how to fill them. Yet, interestingly, when we seek this portrait we find ourselves faced with two pictures. The first picture is the one supported by most of the evidence and is the dismal one referred to above. It is the picture of the average person, including the average professional, being uninterested in and unwilling to use formal information sources. Brittain (1970) says, for example, that there is overwhelming evidence that practitioners don't use the social science literature. Dervin (1976a), in her extensive review of information needs, confirmed that finding across topic areas for adults in the United States.

The picture that emerges is one that shows most citizens, educated or otherwise, essentially relying on close friends and relatives for their information. Media, primarily so-called entertainment television, make up the major portion of the information day. Use of books, newspapers, and magazines is typically low. People seek formal information sources only in a small subset of situations — when all else has failed in coping with a situation or when outside factors force them to. And current efforts to make the information more palatable evidently do not override this essential picture of a "law of least effort" operating.

The only people who deviate from this portrait consistently in the literature are a small group of elite information seekers who have what might be called an "information habit." They are, for example, the small portion of the population that Zwezig (1977) points out are regular, returning library users. While it is true that the elite information seekers tend to be better educated and have higher occupational status than others, this is not a neat and tidy relationship. Most people who are better educated and of higher occupational status do not have the information habit. Yet, some people who are not educated and have lower occupational status are among the elite information seekers.

So we have one picture that is dismal. But there exists in the literature, most clearly in a handful of recent studies and between the lines in not-so-recent studies, another portrait which provides a sharp and, often contradictory, contrast to the first picture. Here what emerges is an average citizen, educated or otherwise, who is a high and purposeful information seeker under some conditions. What are those conditions? Quite simply — the condition of need for information. Thus, for example, Chaifee and Choe (1978) isolated political information use where others had found none by identifying those points of time when citizens were doing their deciding. Stamm and Grunig (1977) did the same on environmental issues by categorizing citizens into groups based on the situations in which they had gaps to bridge. Dervin et al. (1979) did the same with a comparative sample of general population and low-income Asian and black adult residents of Seattle and found that the generalization applied to all their subsamples.

Yet, the statement "people seek information when they need it" sounds tautological, at best — simple-minded, at worst. Nevertheless, it is at the heart of the conflict between the portraits presented above. The first portrait results from research using an observer construction of information; the second results from research using a user construction. The important question that must be asked, then, is what it is that makes the two approaches to looking at information seeking and use differ so radically that they yield such different actuarial portraits. The next section of this paper attempts to unearth these differences and focuses, in particular, at the conceptual level, on the differences in underlying assumptions that guide approaches positing observer versus user constructions of information. The implications of this discussion will be presented in a final section of this paper.
Information as an Observer Construct versus User Construct

The research that has produced the dismal portrait of nonuse of information being characteristic of even educated, professional citizens might best be described as being guided by two central assumptions: one is that information can be treated like a brick; the other is that people can be treated like empty buckets into which bricks can be thrown. Despite many attempts to alter these assumptions, they still guide most communication and information processing research today.

Perhaps the best way of focusing on these assumptions is to suggest that they have their roots in the values about information we inherited from the framework of positivistic physical sciences. The core value we inherited is the belief that information describes a reality that can, given proper controls, be known in an unbiased way. The production of unbiased information is a goal of science. Since information is assumed to describe a knowable reality, then each bit of information has some necessary isomorphic relationship with that reality. Information can be seen as cumulative. And, since it describes a knowable reality, different people observing the same reality should, given proper controls, generate the same information. Conversely, the same bit of information in the hands of different users should lead to the same results.

Set in a row like this, these assumptions may seem like an oversimplified view of what science is about. Yet, when we examine the major conceptual and methodological approaches applied to the study of information-related human behavior, each of these assumptions plays a major role in guiding the work.

Take, for example, the typical study concerned with whether a set of messages has had an impact. The typical methodology is to tap such predictor variables as exposure and such criterion variables as amount of information gained and attitude change. Notice that the model treats the receiver like an empty bucket into which information can be poured. Or, take the typical laboratory study focusing on human information. The usual methodology is to observe how behavior changes given varying conditions for completing prescribed tasks. Again, the human information processor is treated like an empty bucket.

During the early years of communication research, particularly in the advent of the impressive and apparently “empty bucket” type effects of propaganda in World War II, the empty bucket assumptions appeared to receive considerable support in the communication literature. As it turned out, the heyday of direct effects from media information was short-lived, and in retrospect it just happened that the search for effects coincided with a set of conditions in which it is likely to find effects that can be explained as “direct effects” but in actuality are more cohesively explained in other ways.

This point is important and needs an example to become clearer. Perhaps the best example is the evidence in the literature that when technological media are first introduced in a system there is a period of time during which media information seem to produce all kinds of effects. Yet, as time passes, the significant results disappear. The important point here is that while the studies assumed that the information brick was being thrown into the empty bucket, something more fundamental was going on. That “something more fundamental” can be illustrated best with an example.

Say there was a teacher who had never heard of participatory teaching and who didn’t have any opinions one way or the other about the value of having students participate in planning classroom activity. He had never really thought about it or discussed it. Suddenly, in the lunchroom at noon, television tapes synthesizing and interpreting the literature on participatory teaching are aired. Say, too, that the novelty of the new technology was such that for that day, at least, this teacher gave some attention to the show. It is likely, given these conditions, that if we interviewed the teacher shortly thereafter we would find a kind of “empty bucket” direct effect from the program; that is, the teacher would recall information from the tapes and might be interested in using the new technology.

The situational conditions within which we find this teacher (Teacher A) are very much like those of respondents who were interviewed to produce direct effect results in the early days of the introduction of technological media. Notice an important part of the situational conditions is the fact that Teacher A exists essentially in an information vacuum vis-a-vis the subject of the message. This is exactly the situational condition common to most studies showing direct informational effects.

Say, on the other hand, we had two other teachers — B, with a strong opinion inherited from an authoritarian father against student participation, and C, who just came from a high student participation school and had been thinking recently about how to use participation methods in her class. In the case of B, we would get a different result than we did with A — probably rejection of the message and, perhaps, resistance to the new technology as
well. In the case of C, we would get an initial result that looks like the result we got from A — interest in the message, acceptance of some of the premises.

Notice, here, that B — initially opposed — will clearly not fit the empty bucket result pattern. C — initially favorable — will look like she does when in actuality she doesn't. But, despite the fact that C initially looks like the empty bucket that A looked like, over time they will look quite different from each other, with neither of them behaving like empty buckets.

Let's track A and C a bit further to see what happens. A, recall, had no prior information. The situational conditions were such that he did acquire some information from the exposure to the tape. When he went home that night and tried to talk about it with his wife — a former teacher herself — her objections and his lack of experience with the whole idea was such that his hold on the new ideas tumbled apart. Or, say, A ended up in an argument with a colleague opposed to student participation, and the colleague was better informed and got the best of A. Or, say, A tried a few of the ideas in class the next morning and they failed. Or, he tried them twice and they succeeded the first time but not the second. In each of these cases, newly acquired ideas about student participation in classroom planning fell apart. C, on the other hand, had been thinking for months about how to use such techniques and was able to use virtually every idea presented in the tape in the next two weeks in class, modifying some to fit her needs, cautiously testing others.

The discussion above has focused primarily on two particular possible impacts of teacher exposure to the tape about student participation in classroom planning — favorability and adoption — and in only one case of a prior information vacuum did a result obtain that looked like a direct effect or empty bucket effect, and even this appearance was short-lived. If, instead of focusing on attitudes or adoption, we focused on the nature of the ideas our teachers gained, the situational events above would be mirrored in the ideas gained. Given the descriptions of the situational conditions above, we can be sure that our different teachers would be getting quite different ideas from the tape. The diversity would be such that we might be led to wonder if they had, indeed, been exposed to the same message.

As the examples above suggest, direct or empty bucket effects are not what is going on. We all know that. We have long ago accepted the ample evidence on differences in perceptions, ideas, and meanings from the social sciences. But we hang on to the ideas of absolute knowledge and absolute information given to us by science.

Understanding this leads us to understand, for example, why the emphasis on users has been a belated one. In the context of the assumptions detailed above, there is no need for a concern for users. Information is. It has a given relationship with reality. It can be poured as is from one bucket (the system) to another (the user). Its value is obvious — it describes reality, and anything that describes the reality is of value for it allows better adaptation to reality.

Given the conceptual tightness of the absolute information assumptions, we can understand why it would take a great deal of contradictory evidence before alternative frameworks could be generated. A number of researchers have suggested, directly or indirectly, that the scientific emphasis on absolute information has also been the reason why we know so little about human behavior that involves information. Rees and Schultz (1967) suggested, for example, that psychology would be unlikely to provide helpful answers to important questions in information science because of its emphasis on experimental methodologies. Moore and Newell (1974) got closer to the point when they suggested that what is needed for understanding information systems is an understanding of fundamental mechanisms and structures and not the current emphasis in the study of human behavior or behavioral regularities under controlled conditions. Britain (1970) got closest when he observed that we inherited from the natural sciences the assumption of cumulative knowledge which simply does not fit the ways in which information processing occurs in the social sciences.

It is true, of course, that if we start with an assumption of absolute knowledge, it will prescribe certain ways of looking at and studying behavior. The ideas of “bias” and “error” in understanding, for example, assume absolute information and prescribe that what we are trying to do is determine how to get the message past bias and error into the bucket. It is quite a different thing to start with an assumption that lack of bias or error is impossible and an understanding that a focus on bias and error adds no power to a framework. Taking this assumption, what we look at, instead, is how people cope with their worlds — given the constant human imperative of making sense where none is given.11

This is not to say that there aren’t conditions in which we would want to inculcate the assumption of absolute knowledge.12 It is clear, however, based on the literature as it now stands, that the assumption does not work in the arena of the design of human service delivery systems which involve (and this includes virtually all such systems) some kind of information transfer.
The phrase "making sense where none is given" requires more explanation. While we can all agree that there is something "out there," mankind’s dilemma has always been knowing whether what a given person has observed is real at a given point in time and will continue to be real in the future. The constraints on being able to “know” are many and are detailed most clearly by Bronowski (1969, 1973).

First, human observations are done with human perceptual equipment. The equipment, as given on delivery and even in A-1 condition, is limited. For example, a human being can hear only a fraction of all sounds known to be audible to other species. Second, even with human tools, the potential of human observations is limited by external factors. For example, even the power of microscopes is limited by the fact that no microscope can enable observation of units smaller than the smallest light wave.

All of the above constraints are still primarily focused on explaining bias and error in human observations. A third constraint introduces the passing of time and space. As time passes, things change, free-moving entities (for example, people) move around in unpredictable ways. The very passing of time as well as the actions of living entities change nonliving entities. As space changes, the relationships between entities change.

But even beyond time and space, an inherent constraint on human observations is that human perceptual equipment cannot operate without the human mind. The mind runs the whole show. This means that what the human is able to see is prescribed by what is already understood. The infant sees, for example, but does not understand without help. The baby is given a package of understandings from adults. In essence, the child is given sense as if it were real. But in effect it is nothing more than the sense of others.

In Erurer’s (1964, 1973) terms, it is a constant state of the human condition that humankind must “go beyond the information given.” In Carter’s terms (1972, 1974a, 1974b, 1975), humans must instruct themselves in the absence of instruction. In Wilson’s terms (1977): knowledge (or information) is nothing more than the private sense made by someone [perhaps even a collectivity of someone] shared publicly.

The important point here is, when it comes to understanding how and why and with what effect human beings pay attention to, process, and use something that an outside observer calls information, we must start by understanding what the user (or potential user) calls information. Information processing and use are, within the context of relativistic assumptions about information, sense-making activities. The emphasis here is on the word “mak-

The idea that the information brick can be transferred from the system to the empty bucket has generated most of the research available on information-related behaviors. The fact that this research has not been overwhelmingly useful is attested to by the fact that in the disciplines doing such research (for example, psychology, communications) there is currently a major conceptual reexamination going on in an attempt to figure out why so little has been learned from so much effort.

The same basic idea has guided, understandably, the practice of information delivery. And, ironically, study after study attests to the failure of these systems to, for example, yield an informed populace or lead to the use of research and development ideas in professional practice.

Trying to Make the Observer Construct Work

It is clear from the above discussion that positng information as an observer construct was not a useful way of studying human information use. When evidence started accumulating, in the context of research guided by the observer construct, that citizens were not interested in information, there was naturally a turning of attention to the problem of how to get citizens to be more interested. Yet, until very recently, the turning of attention did not involve a focus on the assumptions guiding the research or the assumptions guiding the information construct. Rather, attention was placed on the empty bucket user. In fact, it became clear that the empty bucket was not empty. For if it were, then the information brick would frequently hit home. Instead, it appeared as if instead of being an empty bucket, the receiver was a not-so-empty bucket with a recalcitrant cover and troublesome holes in the bottom. What followed was years of intensive research attempting to find ways to get past that recalcitrant cover and plug those troublesome holes.

Some have suggested that this turning of attention to the user or potential user of the information system is but a case of Western thinking’s penchant for blaming the victim. Yet, at a higher level of abstraction, it appears just one more effect of the acceptance of the assumptions of absolute information. The entire bias-error explanation of why two observers arrive at different observations is, for instance, one of the premises leading to focusing attention on users of systems rather than the systems per se.

However, regardless of what led us there, the result of the crumbling of the empty bucket hypothesis was the directing of a great deal of attention to users and potential users in an effort to
understand why they weren't behaving like empty buckets and to find ways to get them to behave like empty buckets. As we look at this next period in the research, at least three thrusts emerge.

One of these thrusts focused on attempts to identify generalizable information-processing mechanisms which would guide message construction. Typical of this line of research were the myriad studies based on the consistency theories, in which it was posited that the need for balance or consistency was a generalizable cognitive need and that a source, using this principle, could create messages that were more likely to be accepted and used.

While this research tracked many more specific avenues, in broad brush stroke the formidable number of studies conducted in the consistency frame were focused primarily on attempting to create message manipulation situations or explain why they couldn't be created. The results were, despite forays here and there, also consistent in broad brush stroke. The consistency cognitive processing mechanism was not generalizable, although evidence did suggest there were some situations in which it operated. Further, the outsider observer could not set up message situations which he or she thought would call up consistency processing mechanisms and expect that the receiver would agree. In short, one person's inconsistency was not necessarily inconsistency (or even consistency) to another. The bucket was not filled with consistent generalizable across-person communication processing rules that would predict when it behaved like an empty bucket and when it didn't, and thus guide message construction.

Since the generalized cognitive mechanism approach did not work, the next line of attack was obviously to focus solely on the user or potential user of messages. It was hypothesized, for example, that the reason why the consistency theory data didn't turn out as expected is that some people operated under consistency mechanisms while others didn't, and this confounded the data. What has followed has been a large amount of research using personality variables as predictors of message processing and use. Since Allport (1937), the reigning hypothesis has been that personality variables tap relatively stable, highly consistent attributes of people that exert widely generalized causal effects on behavior. When the communications/information processing literature started using personality variables as predictors in the 1960s, many of the personality variables selected were chosen for their potential in predicting what kinds of people were more able to receive messages. An example is the frequent use in the period of some form of an open-versus close-mindedness measure in which the more open-minded subject was hypothesized to be more open to message use, that is, more like an empty bucket.

The best that can be said for the research that resulted from the personality thrust applied to information-communication behaviors is that it is messy, filled with numerous and often conflicting data points, and mostly devoid of any general theory to tie the points together. More critical, however, was the fact that the personality variables were not providing an answer to the failure to predict message processing and use, in particular, and more generally, human behavior.

The psychology field appears to have been the first to note this. Mischel wrote in 1968 that individuals showed far less cross-situational consistency than one would expect based on personality trait theory. In 1969, Endler and Hunt suggested that personality theory wasn't working because behavior was idiosyncratically organized in each individual. In the 1970s, a handful of communications researchers followed with arguments against the use of across-time-space predictors to predict communication-information behaviors.

The essence of their arguments is this: information processing and use are situationally bound behaviors—they occur at specific points in time and space in order to fit the demands at those points in time and space. In short, they suggest that to predict communication-information behaviors, the predictor variables must be selected in a way congruent with the context within which these behaviors are selected (that is, specific moments in time and space) and consistent with the views of the person selecting the behaviors (that is, the individual who is doing the communicating/information processing).

At the same time that the personality predictor approach was in its height, another related approach was also in favor—that of using demographic variables as predictors of communicating/information processing. The arguments levied against personality variables above have also been levied against demographic variables. It is agreed that in a gross way, demographic variables are indicators of the situations within which people live. But the point is that they are very gross and removed from the specific points in time and space when information processing and use occur.

It is also true that the use of demographic variables, unlike the use of personality variables, resulted in a somewhat more stable picture of results. Typical, and firmly supported, findings include the idea that the more educated the citizen, the higher his or her occupational status and income, the more likely it is that that
citizen is informed and in touch with the power of our vast information systems.

Despite the consistency of these findings, several researchers\(^4\) have pointed out the fallacy of these results. An explanation of this is easiest in the context of the idea of observer versus user constructions of information. Say, for example, that a group of school administrators convenes to make judgments about what kinds of information ought to be packaged in a synthesis and interpretation project. They make their judgments based, out of necessity, they choose topics they are interested in and methods of presentation that make sense to them. They then present the resulting materials to their teachers, who ignore them — with the exception of a handful of teachers who are close to the administrators or see themselves as upwardly mobile to administrative positions. The handful of teachers were also college peers of the administrators and had somewhat more experience and education than their fellow teachers. The results of a survey show that only these more seasoned, more educated teachers are information oriented. In essence, then, the finding that the more educated, higher occupational status, higher income citizen has more interest in information really says nothing more than that this citizen has information needs which are similar to those of people in the system who are making decisions on what information needs to fill.

This example serves well for it illustrates what has happened in creating a whole host of myths about the average citizen's (or average professional's) disinterest in information. A group of people assume that their information needs are the information needs and transmit information to others who appear disinterested because they have their own information needs in their own situations.

As we look at these three lines of research — the search for generalizable cognitive mechanisms, the use of personality variables as predictors, and the use of demographic variables as predictors — what stands out more than anything is that they are going in the right direction, but for the wrong reasons. The downfall of the direct effects empty bucket model appropriately directed attention to the user and potential user. But the absolute information assumptions prevented the directing of attention to the system as well. In particular, the absolute information assumptions prevented a focus on attention on the possibility that what the controllers of the system think is information may not be information to the users of the system.

Instead of looking at user information needs, then, what followed was an extended attempt — some 15 to 20 years of research activity that is still going on today — to isolate those users and potential users who will behave like they are supposed to and be interested in a system’s information, or those message construction tools that could be used to get around all the barriers that people seem to put between themselves and information. In essence, the research was trying to find ways to get the not-so-empty buckets to open their covers and plug their holes so the information would get in and stay in.

Perhaps the most interesting aspect of this line of research is the fact that it was constantly flirting with the very ideas that would lead to breaking the absolute information assumptions. Typically, unexpected findings were explained in terms of situational contexts. And theoretical models began to introduce situational and relativistic notions. An example of this distinction was that made in the consistency theory research between message-belief conflicts that occurred before a decision was made versus after a decision was made. Slowly but surely, the studies and their guiding models were moving toward a user's view of the world.

**Information as a User Construct**

We can't say that social science's treatment of the communicating/information processing human being has abandoned the use of information as an absolute or observer-defined construct. The absolute information assumptions still reign. But there is a significant and growing trend in the literature toward an alternate view. In this view, the empty bucket has evolved into a thinking, self-controlling human being. And information changes from brick to clay, moved and shaped in unique ways by each perceiver. This is just a brief outline of the basic ideas in the alternate approach. The purpose of this section is to bring the ideas together and support them with a sampling of recent findings.

This alternate view starts with a number of assumptions, just as the absolute information view started with assumptions. In this alternate view, it is assumed that the individual is a sense maker by mandate of the human condition. Thus, no judge exists of what really is; our perceptual equipment is limited and controlled by our minds so that what is observed is constrained by what our minds envision. People exist at different points in time and space and have the opportunity to observe only a fraction of what is possible.

In a way, then, humans must make sense where none is given because that is the human condition. Most human heads are filled with something we call "knowledge," but in actuality, knowledge is nothing more than the sense made by someone earlier that was
shared and found useful. The important thing about knowledge or any information is that it has not been made our own is that it fits another time and place. If it is to fit our own time and place, it must be treated like clay. We see hundreds of examples of this necessity in daily life. Each individual must deal with the day-by-day conditions of his or her world. All of us are bound by time (it passes) and space (if we are in one place we can't be in another). The understanding created for one time and place doesn't transplant willy-nilly to another.

When you listen to people's reasons for not using or rejecting information, as Dervin et al. (1979) did, what you hear them say most often is, "It didn't fit my circumstances," or "It arrived too late," or "I couldn't make it work for me."

What emerges here is a picture of the information seeker/user who requires what Hollis and Hollis (1969) called "personalized information" and Dervin (1976b) called "information for sense making." The individual, in her time and place, needs to make sense, by definition. But the sense she needs to make is for her world, her time and place. She needs to inform herself constantly. Her head is filled with questions. These questions can be seen as her "information needs." These questions deal with the here and now of the world she sees herself as being in, the places from which she has come, and the places she sees herself going to.

To date, in studies asking people to list the questions they have had as they coped with situations in their lives, the personalized nature of people's information needs has been consistently reported. Questions asked have dealt with locating self and others (Where am I? Where are they?), with finding possibilities (What can I do?) and evaluating possibilities (Will it work?), and with assessing aloneness (Is anyone listening? Doesn't anyone else agree? Am I the only one?). Perhaps the most important aspect of the findings to date is that they support the premise that looking at information relativistically is a more powerful entry for understanding information needs and use. One example of this is that in a exploratory study of graduate students evaluating literature abstracts, the question asked most frequently by the students that was not answered by the abstracts was, "What were the author's motives?" In the world of science reporting, the motives and values of the scientist are excluded. But in the world of the practicing scholar who has to deal with a here and now where sense is not given, such questions are paramount.

Obviously, if information needs arise out of situations, then situational predictors of information processing and use should be more powerful than any of the across-situation predictors tried in the past. This is by far the most supported of the propositions in

dthis relativistic approach to information. In study after study, situational predictors were more powerful statistically than personality or demographic predictors. Thus, for example, Clarke and Kline (1974) found interests of respondents were better predictors of learning from the mass media than education; Donohue et al. (1975) found that the knowledge gap between more educated and less educated adults closed when the issues were of local interest, crisis based, or of broad general concern; Genova and Greenberg (1977) found interest a better predictor of knowledge than education; Edelstein (1974) found that supposedly illiterate respondents were actually literate when it came to reading information for getting jobs; Stamm and Grunig (1977) found that situational differences were more powerful predictors of information seeking than across-time-space attitudinal measures.

While the studies cited above primarily support the conclusion that situational predictors are more powerful than across-time-space predictors, other studies provide insights into the "when" and "what" of information seeking in situations. One conclusion suggested by both Carter et al. (1973) and Grunig and Dibrow (1977) is that the "when" of information seeking is more predictable than the "what." The reason for this, they suggest, goes back to the basic premises about the sense-making individual.

The authors suggest that the sense-making individual essentially operates on the sense already in his or her head — the sense made from experience, listening to parents, school, and so on — until that sense runs out. But sense frequently runs out, for that is the nature of the human condition. It is at that point that sense runs out and the individual is designing new movements that information seeking occurs. Grunig's research has supported this point.

As to the "what" of information seeking, in order to predict it, we need to know more about how the individual sees his or her situation. Dervin et al. (1976, 1979) have done work in this area and found, for example, that the nature of individuals' information needs can be predicted (for example, questions asked while facing a situation) from a knowledge of how individuals see themselves moving in particular situations. Thus, for example, data showed that adults who saw their situations as worries where they had no options for movement more frequently asked questions about whether they were alone, while those who saw their situations as barriers where something they wanted was blocked more frequently asked about procedures for moving.

To date, a battery of different situational variables has been tried, each with more success than across-time-space predictors. These have included interest, degree of involvement, whether the
individual sees constraints in a situation, whether the individual sees the situation as a problem, and whether the individual sees no options or too many for movement.

In addition to a concern for questions of “when” information seeking occurs and “what” the information seeking involves, two other concerns that are spoken to in the alternative view literature are “from whom” and “with what effect.”

The first of these — from whom — deals with sources, and in actuality there appears virtually no data that conflict with the dismal portrait presented in the traditional literature. Most people stick close to home for their information seeking — family, friends, co-workers. Use of electronic media is high and use of print media is low, even among professionals. The difficulty with these findings is how to interpret them. Given that there is a mismatch between system constructions of information and user constructions, it is impossible to know whether low use of existing information systems is a permanent condition or simply a symptom of the mismatch.

One other aspect of source use that is emerging from the new thrust in the literature is the idea of the essential randomness of information seeking. Britain (1970) referred indirectly to this point when he suggested that in the arena of social science materials we cannot expect completeness and representativeness to be a criterion for information retrieval. Hollis and Holleis (1969) spoke to the issue more directly when they suggested that the evidence supports the idea that people seek information from wherever they can get it. Dervin et al. (1976) provide the most direct evidence in describing their respondents as finding information relevant to their interests of the moment in almost everything they saw or read while the situation was active in their minds.

The other concern which the studies using relativistic information frameworks has spoken to is the issue of impacts of information. This concern has received considerable attention in a recent research thrust termed “uses and gratifications.” The essential point here is that the effect of the information received is the use created for it by the user. This assumption is, of course, at marked odds with the research collected within the absolute information framework. There, information had one of two functions. Either it was assumed to make life better for its user because it was said to be a description of reality and thus allow adaptation and accommodation to reality, or it was assumed that its purpose was to achieve the ends of the system — that is, the desired attitude change, the desired knowledge gain, the desired behavior, or at least the desired attention to the message. This latter am-

phasis on ends desired by the system is clear in system emphasis on quantitative exposure measures for accountability purposes. Examples include library circulation, proportion of viewing audience, number of registered users.

All of these assumptions start with an observer’s construction of information. From the perspective of users’ construction of information, clearly users have their own uses for any information they attend to and these uses fit in with the situation they see themselves in. Data from Dervin et al. (1979) show, for example, that uses range from “Helped me decide what to do” to “Helped me get along with him so we could stay married” to “Helped me understand myself better” to “Helped me get away for a while so I could face it again” to “Helped me do a better job and feel better about myself.” What is becoming clear in these results is that the traditional distinctions between information and entertainment, or fiction and nonfiction, have little basis when it comes to the impacts users create.

In sum, then, the growing body of research produced within relativistic information frameworks has generated a small but significant body of results and perspectives for looking at information seeking and use and, thus, ultimately for looking at the design of information systems. The major conclusions about information seeking and use that have been generated to date include:

- information cannot be treated like a brick being thrown from system to user but like clay the user can use for constructing his or her own sense;
- the questions people have about the situations they are in constitute their information needs;
- information needs are always personalized, as there is no other way for them to be;
- information seeking and use can be predicted more powerfully by knowing the kind of situations users are in rather than knowing their personality or demographic attributes;
- people seek information when their life situations are such that their old sense has run out;
- people are in charge of how they use the information they attend to.

Each of these conclusions has implications for the design of any information system and, in the case of this paper, for the design of a synthesis and interpretation system for educationally relevant research and development. These implications for practice are discussed in the next section of this paper.
Implications for System Design

The preceding discussion contrasted two perspectives for looking at information transfer — one, an observer construction, sees information as a brick to be tossed from system to person; the other, a user construction, sees information as clay to be molded and shaped by the perceiver. The observer construction has been and still is the dominant perspective in the social science literature relating to information transfer and in the practice and design of information systems.

The impact of the use of the observer construction on practice is, perhaps, illustrated best with a catalogue of some of the common methods used in information systems. Thus, for example, it is typical practice in U.S. information systems (including mass information systems such as radio, television, and newspapers, and interpersonally based delivery systems, primarily libraries) to:

- transmit information out of context, as disconnected facts, as in spot news;
- require that the source remove his or her values, motives, and frameworks from the reporting, as in television news, textbooks, and scientific writing;
- get input from receivers primarily on a feedback basis to test reactions rather than at a time when the input would result in system design;
- categorize information into rigid classifications which are assumed to represent reality in some way, as in library classification schemes, media programming, or school departments;
- assume that only certain kinds of messages are informing (for example, news, public affairs) while others are not;
- assume that the link between information and its use is inherent in the information and thus de-emphasize the use of how-to-do-it information and case studies;\textsuperscript{25}
- base accountability systems on quantitative measures of exposure, as in audience ratings circulation figures;
- base system design on across-time-space audience analysis, such as personality and demographic profiles.
- find information creators and information disseminators arguing over whether synthesis and interpretation of information adulterates the information.

All of these practices flow from absolute information assumptions. In the context of such assumptions, an emphasis on information takes precedence over an emphasis on users. In the context of relativistic information assumptions, we would expect our information systems to look quite different. For one thing, the user would become the emphasis, the raison d'être. Instead of an emphasis on factualizing, there would be an emphasis on personalizing, as Hollis and Hollis (1969) put it. Instead of an emphasis on document transfer (Brittain's 1970 term), there would be an emphasis on sense making.

Here are some of the more specific practices we might find in a user-based information system:

- frequent use of question-answer formats, as in the so-called "Dear Abby" format;
- frequent use of reporting values, motives, and frameworks for observing along with results of observing;
- frequent reporting of conflicting observations resulting from different frameworks;
- frequent use of case studies in presenting information;
- multiple-category systems for organizing information, with a substantial number being user-based, as in lists of user questions for situation facing;
- frequent use of random samples of users detailing their information needs to determine the content of messages and the nature of systems;
- use of situational analysis of audiences rather than personality-demographic analysis.

An examination of this list suggests, more than anything, that a user-based information system is based on a set of procedures which allow the system to continually respond to the changing needs of its users. It would be a communication-based information system because it would use communication procedures to constantly tap the pulse of its users and the ways in which it can best intersect with its users in their situations.

Conclusion

The purpose of this paper has been to focus on the relevance of information needs to the possible use of synthesis and interpretation strategies as a means of increasing utilization of educationally relevant research and development. The discussion has centered on exploring the conceptual issues involved in focusing on information needs and the resulting data points obtained in research and implications for action.

Since recorded time began, humans have attempted to devise message strategies to increase acceptance of given bodies of information. And since social scientists started measuring, audiences have remained enigmatic and aloof\textsuperscript{26} from the very kinds of in-
formation that well-meaning people have felt would help them best.

On the surface, the use of synthesis and interpretation strategies appears a step in the right direction. Yet it is clear from the literature that unless messages are constructed in terms that have meaning in the day-to-day lives of users and potential users, they won't be used.

To be effective strategies, synthesis and interpretation must do more than reduce the volume of literature by drawing out generalizations or stating major implications for action as seen by experts. Within the context of relativistic information assumptions, a synthesis and interpretation program should start with users by building in procedures which allow user input to the design of the nature and content of the messages and the nature and method of use, as well as to the knowledge to be synthesized and interpreted.

Notes

1. The problem of underutilization of literature is obviously not unique to education. See, for example, Bloom (1959), who discusses the concern for the field of social work, and Britain (1970), who focuses on the general lack of use of social science literature.

2. The idea of “gap” bridging or filling comes from Carter (1972, 1974a, 1974b).

3. The word perceived in the title means nothing more than information needs as defined by the person who has the need. Unless otherwise specified, perceived is assumed throughout this paper whenever the term information need is used.

4. The studies to be relied on here include: the Warner et al. (1973) study of information needs of adult residents of Baltimore; the Gee (1974) replication of the Warner study in Syracuse and Elmira (N.Y.); the Dervin et al. (1976) reconceptualized replication in Seattle; the Palmour et al. (1979) replication of Dervin; and a number of smaller replications of both Warner and Dervin.

5. The abstraction level at which the literature is being reviewed in this paper is such that a great many specific studies will not be cited. The standard texts in given topic areas will be cited, where relevant, as the paper proceeds. In addition, recent studies and essays will be cited, particularly those taking new perspectives that have not yet made it into the mainstream literature. Readers are referred to Littlejohn (1978) for the best overview of communications research in one single-authored text.

6. The ideas presented here were first developed in Dervin (1976a) and expanded in Dervin (1977a, 1977b) and Dervin et al. (1976). I am indebted for the ideas to the works of Bronowski (1969, 1973) and Carter (1972, 1974a, 1974b, 1975).

7. The “brick-throwing” analogy was first developed at Michigan State University with fellow graduate students Joseph Ascroft and Niels Rolings.

8. Dervin (1976c, 1978) has done several reviews which support this point.

9. In constructing this review, the following review texts were heavily relied on: Berlo (1960), Dance and Larson (1976), Klapner (1966), Littlejohn (1978), Mortenson (1972), Schramm (1966, 1973), Sereno and Mortenson (1970), and Thayer (1968).

10. The “empty bucket” analogy has also been referred to as a “hypodermic needle” analogy, with the picture of a hypodermic filled with message producing a direct effect on a receiver (Klapner 1960). The “empty bucket” analogy is used here because it refers less to the idea of direct effects and more to the underlying assumptions behind effects and, for this reason, allows the transfer of the analogy across assumption stages.
11. For other treatments of the ideas presented here see Dervin (1976b, 1977a, 1977b) and Dervin et al. (1976). Others who have made the same point include Bronowski (1956, 1973), Carter (1972, 1974a, 1974b, 1975), Corney (1972), and Simon (1969).

12. Philosophically, of course, neither the assumption of absolute knowledge nor the assumption of relativistic knowledge is testable. The question is which is more useful for the task at hand.

13. For examples of these reviews, see Dervin (1976a), Hewes et al. (1976), and Mischel (1976).


15. For comprehensive surveys, see Abelson et al. (1968), Greenwald et al. (1968), Insko (1967), and Kiesler et al. (1969).

16. For reviews, see McGuire (1968) and Borgatta and Lambert (1967).


18. For a review of these critiques, see Dervin (1977b).

19. These studies have been done by Dervin and colleagues and will be reported in an upcoming book, The Human Side of Information. Expectec to be published in 1982. Available now in report form is Dervin et al. (1976).

20. Note that the situational predictor must be one assessed by the respondent and not the researcher or the result will be a catapulting back into absolute information assumptions.

21. In addition to those cited above, others are issuing calls for situationally based analyses — see, for example, Cappella (1977), Davis (1977), and Rotter et al. (1972).


23. Dervin et al. (1977) looked at system versus user constructions of information by comparing the ways of looking at information seeking of citizens to the predictions of citizens by information practitioners in human service delivery agencies and librarians in public libraries. The results showed a mismatch along the lines predicted by the discussion in this paper.

24. See, in particular, Blumler and Katz (1974), Blumler (1979), and Swanson (1979). The discussion here is based on the Dervin et al. (1979) use of the uses and gratifications approach.

25. Several (Dervin and Greenberg 1972, Lemert et al. 1977, and Wade and Schramm 1969) have researched what they have called ways-means information or mobilizing information and concluded that while the media de-emphasize t, people need it.


References


MODELS IN INFORMATION BEHAVIOUR RESEARCH

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This paper presents an outline of models of information seeking and other aspects of information behaviour, showing the relationship between communication and information behaviour in general with information seeking and information searching in information retrieval systems. It is suggested that these models address issues at various levels of information behaviour and that they can be related by envisaging a 'nesting' of models. It is also suggested that, within both information seeking research and information searching research, alternative models address similar issues in related ways and that the models are complementary rather than conflicting. Finally, an alternative, problem-solving model is presented, which, it is suggested, provides a basis for relating the models in appropriate research strategies.

1. INTRODUCTION

The aim of this paper is to review the status of models of information behaviour* to discover how they may relate one to another and, perhaps, propose an integration of the models into a more general framework. To this end, this paper offers a view of the existing research as a set of 'nested' models bound together by a dependency upon one another and by an increasing concern, as we move to deeper levels, with finer and finer details of human information seeking and searching behaviour.

* By information behaviour is meant those activities a person may engage in when identifying his or her own needs for information, searching for such information in any way, and using or transferring that information.

Research in information behaviour has occupied information scientists since before the term ‘information science’ was coined. We can take its origins back to the Royal Society Scientific Information Conference of 1948 [1], when a number of papers on the information behaviour of scientists and technologists were presented. Of course, the term information behaviour was not used in the papers, which were generally about document and library use, but the origins are clearly there. This was seven years before Chris Hanson (of Aslib) coined the term ‘information science’ and ten years before the establishment of the Institute of Information Scientists in the UK, the first professional society devoted to the field.

Over the intervening period since the Royal Society Conference literally thousands of papers and research reports have been produced on user needs, information needs, and information-seeking behaviour (see, for example: [2-6]). Throughout the period the one constant complaint of commentators has been that researchers have not built upon prior research in such a way as to cumulate a body of theory and empirical findings that may serve as a starting point for further research.

A number of reasons can be advanced for this situation: first, in the positivist tradition, quantitative research methods were adopted that were inappropriate to the study of human behaviour; many things were counted, from the number of visits to libraries, to the number of personal subscriptions to journals and the number of items cited in papers. Very little of this countering revealed insights of value for the development of theory or, indeed, of practice. Secondly, researchers in the field of information science seem generally to have ignored allied work in related areas that might offer more robust theoretical models of human behaviour (see Wilson [7] for a review of such research). Thirdly, general models of information behaviour have only begun to emerge, and attract much attention, in the past ten to fifteen years.

The situation is now changing (as Wilson has suggested [3]): the general adoption of qualitative methods (from the early 1970s in the UK) has resulted in work that is in the wider tradition of the investigation of human behaviour and which, therefore, is more likely to find theories and models in the social sciences that can be applied to the study of information behaviour. At the same time, the models and theories proposed by certain researchers (e.g. Dervin, Ellis, Kuhlthau, Wilson), have gained strength as they have been adopted as the basis for further research by other investigators.

2. A MODEL OF INFORMATION BEHAVIOUR

A model may be described as a framework for thinking about a problem and may evolve into a statement of the relationships among theoretical propositions. Most models in the general field of information behaviour are of the former variety: they are statements, often in the form of diagrams, that attempt to describe an information-seeking activity, the causes and consequences of that activity, or the relationships among stages in information-seeking behaviour. Rarely do such models advance to the stage of specifying relationships among theoretical propositions: rather, they are at a pre-theoretical stage, but may suggest relationships that might be fruitful to explore or test.

Figure 1. Wilson’s model of information behaviour

Models of information behaviour, however, appear to be fewer than those devoted to information-seeking behaviour or information searching. Figure 1 is a variation on Wilson’s model of 1981 [8].

The aim of this model was to outline the various areas covered by what the writer proposed as ‘information-seeking behaviour’, as an alternative to the then common ‘information needs’, but it is clear that the scope of the diagram is much greater and that it attempts to cover most of what is included here as ‘information behaviour’.

The model suggests that information-seeking behaviour arises as a consequence of a need perceived by an information user, who, in order to satisfy that need, makes demands upon formal or informai information sources or services, which result in success or failure to find relevant information. If successful, the individual then makes use of the information found and may either fully or partially satisfy the perceived need - or, indeed, fail to satisfy the need and have to reiterate the search process. The model also shows that part of the information-seeking behaviour may involve other people through information exchange and that information perceived as useful may be passed to other people, as well as being used (or instead of being used) by the person him/herself.

One of the results of the analysis that led to the diagram was the recognition that information use had received little attention and, within information science, that statement is still relatively true today. Nor has much attention been devoted to the phenomenon of the informal transfer of information between individuals since Allen’s pioneering work [9] on transferring to the research laboratory the ‘two-step’ flow of communication model of the ‘gatekeeper’. The identification of these areas as relatively lacking in research attention demonstrates one of the functions of these models.

The limitation of this kind of model, however, is that it does little more than provide a map of the area and draw attention to gaps in research; it provides no
suggestion of causative factors in information behaviour and, consequently, it
does not directly suggest hypotheses to be tested.

3. MODELS OF INFORMATION-SEEKING BEHAVIOUR

When we turn to information-seeking behaviour the models are rather more
numerous: five will be discussed here: Wilson’s (1981) model of information-
seeking behaviour [8]; Dervin’s (1983) Sense-Making theory [10]; Ellis’s (1989
and 1993) behavioural model of information seeking strategies [11, 12];
Kuhlthau’s (1991) model of the stages of information-seeking behaviour [13];
and Wilson’s (1996) model [2, 7], which expands his 1981 model through an
analysis of the literature in fields other than information science.

3.1 Wilson, 1981

Wilson’s second model of 1981 is based upon two main propositions: first, that
information need is not a primary need, but a secondary need that arises out of
needs of a more basic kind; and second, that in the effort to discover information
to satisfy a need, the enquirer is likely to meet with barriers of different kinds.
Drawing upon definitions in psychology [14], Wilson proposes that the basic
needs can be defined as physiological, cognitive or affective. He goes on to note
that the context of any one of these needs may be the person him- or herself, or
the role demands of the person’s work or life, or the environments (polical, eco-
nomic, technological, etc.) within which that life or work takes place. He then
suggests that the barriers that impede the search for information will arise out of
the same set of contexts.

This model is shown in a simplified version (which also shows the search behaviours defined by Ellis [11] in Figure 2). Wilson’s model is clearly what may be
described as a macro-model or a model of the gross information-seeking
behaviour and it suggests how information needs arise and what may prevent
(and, by implication, aid) the actual search for information. It also embodies,
implicitly, a set of hypotheses about information behaviour that are testable: for
example, the proposition that information needs in different work roles will be
different, or that personal traits may inhibit or assist information seeking. Thus,
the model can be regarded as a source of hypotheses, which is a general function
of models of this kind.

The weakness of the model is that all of the hypotheses are only implicit and
are not made explicit. Nor is there any indication of the processes whereby con-
text has its effect upon the person, nor of the factors that result in the perception
of barriers, nor of whether the various assumed barriers have similar or different
effects upon the motivation of individuals to seek information. However, the very
fact that the model is lacking in certain elements stimulates thinking about the
kinds of elements that a more complete model ought to include.

3.2 Dervin, 1983, 1996

Dervin’s Sense-Making theory has developed over a number of years, and cannot
be seen simply as a model of information-seeking behaviour: it is, rather, as she
says [10], ‘… a set of assumptions, a theoretic perspective, a methodological
approach, a set of research methods, and a practice’ designed to cope with infor-
mation perceived as, ‘… a human tool designed for making sense of a reality
assumed to be both chaotic and orderly’.

However, Sense-Making is implemented in terms of four constituent elements:
a situation in time and space, which defines the context in which information
problems arise; a gap, which identifies the difference between the contextual
situation and the desired situation (e.g. uncertainty); an outcome, that is, the con-
sequences of the Sense-Making process, and a bridge, that is, some means of
closing the gap between situation and outcome. Dervin presents these elements in
terms of a triangle: situation, gapbridge, and outcome, which can be represented
as in Figure 3. However, it may be preferable to use the bridge metaphor more
directly and present the model as Figure 4.

The strength of Dervin’s model lies partly in its methodological consequences,
since, in relation to information behaviour, it can lead to a way of questioning that
can reveal the nature of a problematic situation, the extent to which information
serves to bridge the gap of uncertainty, confusion, or whatever, and the nature of
the outcomes from the use of information. Applied consistently in ‘micro-moment,
time-line interviews; such questioning leads to genuine insights that can influence information service design and delivery, e.g. [15, 16].

3.3 Ellis, 1989 and Ellis, Cox and Hall, 1993
Ellis’s elaboration of the different behaviours involved in information seeking is not set out as a diagrammatic model and Ellis makes no claims to the effect that the different behaviours constitute a single set of stages; indeed, he uses the term ‘features’ rather than ‘stages’. These features are named and defined below:

- **starting**: the means employed by the user to begin seeking information, for example, asking some knowledgeable colleague;
- **chaining**: following footnotes or citations in known material or ‘forward’ chaining from known items through citation indexes;
- **browsing**: ‘semi-directed or semi-structured searching’ (Ellis [11, p. 187])
- **differentiating**: using known differences in information sources as a way of filtering the amount of information obtained;
- **monitoring**: keeping up-to-date or current awareness searching;
- **extracting**: selectively identifying relevant material in an information source;
- **verifying**: checking the accuracy of information;
- **ending**: which may be defined as ‘tying up loose ends’ through a final search.

The strength of Ellis’s model, as with Kuhlthau’s, is that it is based on empirical research and has been tested in subsequent studies, most recently in the context of an engineering company [17].

Of the features, Ellis notes that: ‘the detailed interrelation or interaction of the features in any individual information seeking pattern will depend on the unique circumstances of the information seeking activities of the person concerned at that particular point in time’ [11, p. 158]. However, it is clear that ‘starting’ must initiate a process and that ‘ending’ must end it. It also seems reasonable to suggest that ‘verifying’ is a penultimate stage in a process and that ‘extracting’ must follow on from a specific search behaviour such as ‘browsing’. Indeed, drawing attention to this fact leads to the conclusion that ‘extracting’ is not an information behaviour of the same kind as ‘browsing’, or ‘chaining’ or ‘monitoring’, and further suggests that ‘differentiating’ is also a different kind of behaviour: browsing, chaining and monitoring are search procedures whereas differentiating is a filtering process and extracting may be seen as an action performed on the information sources.

![Figure 4. Dervin's Sense-Making framework modified](image)

![Figure 5. A stage process version of Ellis's behavioural framework](image)

The remaining behaviours do not necessarily take place in a specific sequence and may be initiated in different sequences at different times in the overall search process. Ellis’s account, therefore, in terms of the different kinds of features it embodies, appears to sit between the micro-analysis of search behaviour (starting, chaining, extracting, verifying, ending) and a more macro-analysis of information behaviour generally (browsing, monitoring, differentiating).

If these points are accepted, it is then possible to suggest a diagrammatic presentation of the model, as in Figure 5.

Thus, the models of Wilson and of Ellis are intended to function at different levels of the overall process of information seeking and this fact is demonstrated by the ability to nest one within the other.

3.4 Kuhlthau, 1991
Kuhlthau’s work [13, 18] complements that of Ellis by attaching stages of the ‘information search process’ the associated feelings, thoughts and actions, and the appropriate information tasks. This association of feelings, thoughts and actions clearly identifies Kuhlthau’s perspective as phenomenological, rather than cognitive. The stages of Kuhlthau’s model are: Initiation, Selection, Exploration, Formulation, Collection and Presentation. As an example, the initiation phase of the process is said to be characterised by feelings of uncertainty, vague and general thoughts about the problem area, and is associated with seeking background information; the ‘appropriate task’ at this point is simply to ‘recognise’ a need for information. The remaining appropriate tasks are: Identify, that is, fix the general topic of the search; Investigate, or search for information on that general topic; Formulate, focus on a more specific area with in the topic; Collection, that is, gather relevant information about the focus; and, Complete, end the information search.

Kuhlthau’s model is thus more general than that of Ellis in drawing attention to the feelings associated with the various stages and activities. In this regard, Kuhlthau acknowledges her debt to Kelly’s ‘personal construct theory’ [19] which describes the affective experience of individuals involved in the process of constructing meaning from the information they encounter [20]. The fundamental proposition is that the feelings of uncertainty associated with the need to search for information give rise to feelings of doubt, confusion and frustration and that, as the search process proceeds and is increasingly successful, those feelings change; as relevant material is collected confidence increases and is associated with feelings of relief, satisfaction and a sense of direction.
In effect, what Kuhlthau postulates here (and confirms by empirical research) is a process of the gradual refinement of the problem area, with information searching of one kind or another going on while that refinement takes place. Thus, a successive search process is implicit in Kuhlthau’s analysis of the search activity. Although Kuhlthau’s early work was a series of longitudinal studies of high school students, more recently she has shown the applicability of the model to the work of a securities analyst [21].

It is interesting to explore whether the Ellis and Kuhlthau models may be brought together, and this is attempted in Figure 6, where my representation of Ellis’s categories is accompanied by the stages of Kuhlthau (the latter in italic).

Through this merger of the two models, we can see strong similarities and the major difference appears to be that Ellis specifies the modes of exploration or investigation. The point must be reiterated, however, that Ellis does not present his characteristics as stages but as elements of behaviour that may occur in different sequences with different persons, or with the same person at different times. Thus, the two models are fundamentally opposed in the minds of the authors: Kuhlthau posits stages of the basis of her analysis of behaviour, while Ellis suggests that the sequences of behaviour characteristics may vary.

3.5 Wilson, 1996

Wilson’s 1996 [22] model (Figure 7) is a major revision of that of 1981, drawing upon research from a variety of fields other than information science, including decision-making, psychology, innovation, health communication and consumer research.

The basic framework of the 1981 model persists, in that the person in context remains the focus of information needs, the barriers are represented by ‘intervening variables’ and ‘information-seeking behaviour’ is identified. However, there are also changes: the use of the term ‘intervening variables’ serves to suggest that their impact may be supportive of information use as well as preventive; information-seeking behaviour is shown to consist of more types than previously, where the ‘active search’ was the focus of attention; ‘information processing and use’ is shown to be a necessary part of the feedback loop, if information needs are to be satisfied; and three relevant theoretical ideas are presented: stress/coping theory [22], which offers possibilities for explaining why some needs do not invoke information-seeking behaviour; risk/reward theory [23, 24], which may help to explain which sources of information may be used more than others by a given individual; and social learning theory, which embodies the concept of ‘self-efficacy’, the idea of ‘the conviction that one can successfully execute the behavior required to produce the desired outcomes’ [25].

Thus, the model remains one of macro-behaviour, but its expansion and the inclusion of other theoretical models of behaviour make it a richer source of hypotheses and further research than Wilson’s earlier model.

We can also attempt to relate this model to the others discussed above. It is fairly obvious that the models of both Ellis and Kuhlthau relate to the active search mode of information-seeking behaviour and provide, in effect, an expansion of that box in the diagram above. Dervin’s model is completely different in character, since its aim is to provide a framework for exploring the totality of information behaviour from the exploration of the context in which information needs arise to the means whereby that need is satisfied, whether through active searching or otherwise. In effect, it is a model of a methodology, rather than a model of a set of activities or a situation.

4. SUMMARY OF THE INFORMATION BEHAVIOUR MODELS

I have labelled these models ‘information behaviour’ models because it is clear that they are not ‘information search’ models in the sense that might be understood by the information retrieval researcher. They are concerned with, on the one hand, generalised behaviours surrounding the actual initiation of information-seeking
and, on the other, with a broader perspective of the information retrieval systems. This is an important point to make, since the implications for IR systems from research in the general area of information behaviour may inform the overall design principles of such systems, and may enable the information content developer to specify more clearly what navigational routes are needed through the information and exactly what kind of information or data types need to be in the record, but the specification of rules for the design of interactive systems on the basis of information behaviour research may not be possible. Thus, from Wilson's 1996 model we can reasonably hypothesise that an IR system should be designed so as to reduce the risk of failure by the user, and thereby, increase his or her sense of self-efficacy, but the means whereby the risk is reduced must be a matter for the system designer. However, better systems are likely to be designed if the designer understands the ideas of risk/reward and self-efficacy.

Again, Ellis's work suggests that an IR system ought to provide more navigational routes for the user, providing not only Boolean or best-match search strategies, but also the capacity to chain through citations in texts both backwards and forwards in time, and with intelligent agents to monitor additions to the database according to, say, the user's last search or an established profile.

Similarly, given that virtually all studies of information-seeking behaviour show the importance of personal networks, IR systems could well embody routines that would enable users to indicate their willingness to be put in contact with others interested in the same research areas. By doing so, IR systems could become genuine tools for collaborative work, not only within but across disciplines: the potential for this has been made real by the development of the Internet and by modern software tools that allow the 'desk-top' to act as the interface to the Internet and World Wide Web.

5. INFORMATION SEARCHING MODELS

The relationship between information-seeking behaviour in the general sense and information retrieval behaviour is obviously a close one: the use of IR systems is one possible strategy in the collection of information and, hence, constitutes a potential sub-stage in the information-seeking process.

'From the perspective of the interaction of users with IR systems, Saracevic [26] has provided a useful review of the various models of users in interaction with IR systems. Saracevic identifies three models: the traditional model, which 'represents IR as two pronged set (system and user) of elements and processes converging on comparison or matching'; Ingwersen's cognitive model [27], which 'concentrates on identifying processes of cognition which may occur in all the information processing elements involved'; and Belkin's 'episode model' [28], which 'considers user interaction with an IR system as a sequence of differing interactions in an episode of information seeking'. Saracevic then goes on to propose what he calls a 'stratified interaction model' developed within an overall framework of an 'acquisition-cognition-application' model of information use. The levels or strata posed by Saracevic are simplified (in his words) to three: 'surface', or the level of interaction between the user and the system interface;

Figure 8. Ingwersen's model of the IR process

'cognition', or the level of interaction with the texts or their representation; and the 'situation', or the context that provides the initial problem at hand.

Ingwersen's model is shown in Figure 8. When we examine this model, we can see its close family resemblance to other models of information seeking behaviour. In particular, the elements 'user's cognitive space' and 'social/organisational environment' resemble the 'person in context' and 'environmental factors' specified in Wilson's models and the general orientation towards queries posed to an IR system point to a concern with the 'active search', which is the concern of most information-seeking models. Ingwersen, however, makes explicit a number of other elements: first, he demonstrates that within each area of his model the functions of the information user, the document author, the intermediary, the interface and the IR system are the result of explicit or implicit cognitive models of the domain of interest at that particular point. Thus, users have models of their work-tasks or their information needs, or their problems or goals, which are usually implicit, but often capable of explanation. Again, the IR system is an expression of the system designer's cognitive model of what the system should do and how it should function. Secondly, Ingwersen brings the IR system into the picture, suggesting that a comprehensive model of information-seeking behaviour must include the system that points to the information objects that may be of interest to
the enquirer. Thirdly, he shows that various cognitive transformations take place in moving from the life-world in which the user experiences a problem or identifies a goal to a situation in which a store of pointers to information objects can be satisfactorily searched and useful objects identified. Finally, he points to the need for these models or cognitive structures and their transformations to be effectively communicated throughout the 'system', which will include the user, the author and the IR system designer.

Thus, Ingwersen's model, to a degree, integrates ideas relating to information behaviour and information needs with issues of IR system design, and this, together with the focus on cognitive structures and the idea of polyrepresentation, is an important strength of the model. Saracevic suggests that [26]: 'The weakness is in that it does not provide for testability... and even less for application to evaluation of IR systems'. However, recently, Borlund and Ingwersen [29] have developed and tested an evaluative strategy on the basis of this model and have demonstrated its value in testing interactive IR systems. A potential weakness that remains is that the whole of information behaviour as defined in other models examined in this paper is subsumed under the heading of the 'user's cognitive space'. Issues of how users arrive at the point of making a search, and how their cognitive structures are affected by the processes of deciding how and when to move towards information searching, may be lost. From the point of view of Wilson's 1996 model, the significant part of Ingwersen's model (apart from its explicit cognitive theory orientation) is in the description of the 'active search' process and the elements of that process.

Belkin's 'episodic' model might be better termed an 'activity' model or 'interaction' model, since its focus is upon the actions carried out in an information search, from 'scanning' to 'searching', within a framework of other dimensions: the 'goal of interaction' (learning-selecting); 'mode of retrieval' (recognition-isation); and 'resource considered' (information-meta-information). According to Belkin et al. [28]: 'Any single ISS (information-seeking strategy) can be described according to its location along these four dimensions'. However, in the terminology used in this paper, this would be better described as information-seeking strategies, since, although couched in terms of a generalised interaction between information-searcher and information-provider, the focus of Belkin's work is on the design of IR systems.

Belkin and his colleagues then advocate the evolution of 'scripts' or plans... for a dialogue between the user and the rest of the system. Such scripts, based on the observation of people as they engage in information seeking, could be used as a means for structured human-computer interaction aimed at achieving the goal of that particular ISS. While such a goal appears desirable, there may, of course, be significant problems in identifying sufficiently generalised behaviour to produce a limited range of scripts for IR system use. If, however, the underlying rules or script could be from user input could be determined, a more intelligent system might be devised which would create an appropriate script in response to the user's initial interactive behaviour.

Saracevic's own model (Figure 9) is described as a 'stratified interaction model' and postulates a three-level structure: surface, cognitive, and situational. Again, this model shows a strong resemblance to that of Ingwersen. At the surface level, a user interacts with a system through an interface by issuing commands or queries that represent, in some way, a problem statement. At the same level, the system responds either with meta-information, or texts (including images, etc.) or with queries of its own designed to elicit from the user further information on the nature of the problem. At the cognitive level, the user interacts with the output of the system, or with texts obtained subsequent to system interaction, in ways that enable the user to assess the utility of the text in relation to the initial problem. At the situational level, '... users interact with the given situation or problem-at-hand which produced the information need and resulting question. The results of the search may be applied to the resolution or partial resolution of the problem'.

Spirko proposes a model of the search process, derived from empirical research, which identifies user judgements, search tactics or moves, interactive feedback loops, and cycles as constituting the search process of a person in interaction with an IR system [30]. The model is shown, in simplified form, in Figure 10.

Spirko describes the model as follows:

Each search strategy may consist of one or more cycles (one or more search commands ending in the display of retrieved items...). Each cycle may consist of one or more interactive feedback occurrences (use: input, IR system output, user interpretation and judgement, user input). An input may also represent a move within the search strategy...
regarded as a search tactic to further the search. Each move consists of a user input or query requesting a system's output" [30, p. 392].

The value of this view of IR interaction is that it is based directly on empirical research and that the appearance of user judgements, search tactics and interactive feedback loops links IR interaction directly with information-seeking behaviour in general. Thus, judgements made by users must be based upon prior experience gained in the overall activity of information seeking, and tactics and moves may well be derived from behaviour that proves to be useful in settings other than the interactive IR system.

6. DISCUSSION

Models of information behaviour do not all attempt to describe the same set of phenomena or activities: some, as in the case of Ellis [11] are concerned with behavioural patterns in the actual search activity; others, like Kuhlthau [18] present stages of activity, within which the behavioural patterns may occur. The model presented here is of this second type in that it presents problem solving as the overall framework for the activity of information seeking and shows that Kuhlthau's model may fit within the various stages of the information seeking process. We can also suggest that Ellis's behavioural model is a set of activities within what Kuhlthau calls 'collection' and that all three of these are nested within Wilson's 1996 model of information behaviour in general.

This analysis of various models leads me to suggest that the various areas of research within the general field of information behaviour may be seen (as

intimated above) as a series of nested fields: information behaviour may be defined as the more general field of investigation (as shown in Figure 11), with information-seeking behaviour being seen as a sub-set of the field, particularly concerned with the variety of methods people employ to discover, and gain access to information resources, and information searching behaviour being defined as a sub-set of information-seeking, particularly concerned with the interactions between information user (with or without an intermediary) and computer-based information systems, of which information retrieval systems for textual data may be seen as one type.*

We might also extend the nested model further by showing that information behaviour is a part of human communication behaviour, given the amount of information-related research in various aspects of communication studies, such as that on consumer behaviour, it may be particularly useful to remember this in certain contexts. There are models in the field of communication theory that are of interest to the information researcher (see [32] for a review of these) most of which take the Shannon and Weaver [33] communication model as their starting point. In particular, the model of Maletzke [34] shows aspects of the communication process that are either included in one or other of the models presented here or could be added to the models to make them more all-inclusive; for example, he suggests that the receiver's (user's) self-image and the receiver as a member of the audience are aspects to be considered. Maletzke, of course, also details aspects of the 'communicator' that need to be considered in a full elaboration of

*An anonymous reviewer drew my attention to a similar nested model in Rasmussen et al. [31], which, although not directly related, offers a basis for incorporating information-seeking behaviour within a general model of task performance and analysis.
communication: self-image, personality structure, working team, social environment, organisation, and ‘pressure and constraints caused by the public character of the media content’.

The focus of studies in information behaviour is on the information seeker of known or unknown communications, while, although the communication recipient is considered in research in communication studies, there is also a strong focus upon the communicator and the channels of communication. So, while attention is drawn to the connection here, Figure 1 does not include communication studies as an all-embracing field. However, we can show the general relationship between communication and information-seeking behaviour in Figure 12.

The diagram simplifies Figure 7, renames information sources ‘channels of communication’, links the basic model to the communicator as the originator of messages over the channels of communication and shows a feedback loop through which the communicator learns of the recipient’s response to the communication. Enlarging the original model in this way enables us to link the two fields and may enable us to identify and consider relationships in the information-seeking process that have not had detailed treatment in information science research.

We can also suggest that the areas in Figure 12 interact with the field of human-computer interaction (HCI) as indeed they must and, because HCI is concerned with all aspects of human and computer interaction, including computer-based information retrieval, we can perceive it as a related field that intersects with communication behaviour and its sub-fields.

This nested model may be used by researchers in the various fields to remind themselves that the study of a particular topic needs to be undertaken in the context of the surrounding field: thus, information searching should be explored with an understanding of information seeking and the latter with an understanding of information behaviour in general. We can also argue that research may concern itself with one of these fields, as a central subject for investigation, but also that an investigation could, in fact, explore the relationships across the fields. We can envisage this as taking a slice across the circles to explore the behaviour of a group or an individual in terms of overall information behaviour, information-seeking

Figure 12. Linking information seeking and communication

7. ANOTHER MODEL

Given the abundance of models in the field, it may seem unhelpful to introduce another, but this model is intended (although it may not accomplish this) to provide a kind of linking or integration of at least some of the models discussed above. This entire paper was stimulated by reading a paper by Saracevic [35], in which he comments: ‘If the IR pioneers did not embrace relevance, but let [sic] say uncertainty as the basic notion, IR theory, practice, and evaluation would have looked very different’.

It occurred to me that, although the concept has not been used in evaluating IR systems (as Saracevic rightly says), nevertheless, it is, in effect, ‘the ghost at the feast’ since we may assume that much (perhaps most?) information seeking and retrieval are occasioned by uncertainty. Research in IR evaluation may not have made much of the idea, but, from the perspective of the user, it is always there. In the field of communication theory, also, uncertainty has a place in some writers’ work: for example, Newcomb [36] suggests that communication is a ‘learned response to strain’ (taking us back to the idea of stress as a causal factor) and that we are more likely to find increased communication activity in the form of information seeking, giving and exchange ‘under conditions of uncertainty and disequilibrium’.

If we accept this proposition, we will naturally ask, ‘What is the cause of the uncertainty?’ A generalised answer is, ‘a problem’: the problem may be more or less recognisable as a problem in the normal sense of the word, but something in the individual’s life-world, which may be the world of everyday life of the citizen, or the world of work of the scientist, professional worker, or whatever, has led in Schutz and Luckmann’s terms [37] to a discrepancy between the typifications applied to the life-world and a phenomenon that, at first sight, cannot be fitted into these typifications. In other words, the individual is faced with a problematic situation.*

The solution of the problem, the resolution of the discrepancy, the advance from uncertainty to certainty (or at least some pragmatic solution of the problem) then becomes a goal of the person and we typify the resulting behaviour as goal-seeking

*Schutz’s notion of typification can be explained by quotation: ‘What is newly experienced is already known in the sense that it recalls similar or equal things formerly perceived. But, what has been grasped once in its typicality carries with it ... a series of typical characteristics still not actually experienced but expected to be potentially experienced’ [38]. Thus, once we have experienced any phenomenon we have certain expectations of things we expect to be similar - we typify them as belonging to particular categories of our experience of the world. Once I experience a tree, I have certain expectations of anything that occurs in my life-world as being tree-like; it will be rooted in one place, rather than moving; if my first experience has been in the summer-time, a tree-like object will be expected to have leaves, and so on. Similarly, we identify all kinds of events in our life-worlds as being similar to previously experienced events. Schutz makes the connection between relevance and typification, in that those facts or experiences that enable us to identify phenomena as members of a particular object group or sub-set of such a group may be viewed as relevant to the typification of these phenomena.
behaviour. We then argue that en route to the goal, the individual moves from uncertainty to increasing certainty and that there are stages in the problem-resolution process that are identifiable and recognisable to the individual. These stages are: problem identification (where the person is asking the question, "What kind of problem do I have?"); problem definition ("Exactly what is the nature of my problem?"); problem resolution ("How do I find the answer to my problem?") and, potentially, solution statement ("This is the answer to the problem", or, if a pragmatic, rather than a theoretically-based resolution has been found, "This is how we are going to deal with the problem.")

Clearly, the transition from problem identification to solution statement is not without difficulty; if it was, there would be no problem, since (as Schutz and Luckmann argue) the issue would be dealt with through the individual's existing typifications of phenomena in the life-world and his or her existing stock of knowledge applicable to those typifications. We hypothesise that, (a) each stage sees the successive resolution of more and more uncertainty, and (b) where uncertainty fails to be resolved at any one stage, it may result in a feedback loop to the previous stage for further resolution. We may represent this as in Figure 13.

In other words, and for example, failure to find a useful definition of the problem may result in a return to the problem identification stage, for further consideration of the problematic situation if the uncertainty-resolution loop fails.

The important question at this point is, "How is uncertainty resolved?" This is where we can bring into the model the previous attempts at modelling information behaviour and, specifically, those of Kuhlthau and of Ellis. One proposition may be that Kuhlthau's 'stages' can be seen not as steps in a single information seeking activity, but reiterated steps that may occur in exploratory loops between each link in the problem resolution chain shown above. The clue to this is Kuhlthau's suggestion that Collection (identified as one of the stages) actually takes place within other stages and it is reasonable to ask, therefore, why Collection should be typified as a separate, single stage, when it recurs.

Kuhlthau's model (discussed earlier) has the stages Initiation, Selection, Exploration, Formulation, Collection, and Presentation, which are described more fully above. The model proposed here suggests that some of these terms can be used to identify the stages through which an individual moves to resolve uncertainty:

\[
\text{uncertainty} \rightarrow \text{initiation} \rightarrow \text{selection} \rightarrow \text{exploration} \rightarrow \text{formulation} \rightarrow \text{collection} \rightarrow \text{formulation/reformulation} \rightarrow \text{resolution}
\]

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Alternatively, we might use Ellis's behavioural model with its 'features' (starting, browsing, chaining, etc.) as the basis for an in-depth analysis of the reiterated search activities at each phase of the problem-solving process.

The idea that problem solving is the underlying motivation for information searching is supported by Spink and Greisdorf on partial relevance [39]. In an analysis of three studies of information search behaviour Spink and Greisdorf show that the assessment by users of documents as partially relevant correlates highly with variables such as a change in the user's definition of the problem, a change in the user's relevance criteria, and a change in the user's knowledge of the problem. Spink and Greisdorf note that the assumptions of research into IR system use that only the highly relevant items retrieved in a search are valued by users and that categorical scales of relevance can be conflated to binary scales (relevant/non-relevant) without loss of information, are erroneous and need to be addressed by IR researchers.

Given the findings of Spink and Greisdorf, the model of information search behaviour suggested above may provoke a sound basis for the development of research ideas.

8. CONCLUSION

The various models of information behaviour, information-seeking behaviour and information searching represent different aspects of the overall problem: they are complementary, rather than competing, as Figure 4 suggests. The key questions for research, therefore, are:

- to what extent are the different models complete, or reasonably complete representations of the reality they seek to model?
- in what ways are the models complementary; that is, how does knowledge of one level of analysis aid another?
- specifically, in the case of information-searching behaviour; how does knowledge of modes of information-seeking behaviour aid our understanding of the search process, if at all?

Research to answer the last question might best focus on projects that take a view of information searching as a complex process embedded in the broader perspective of information-seeking behaviour, and information behaviour in general, rather than on the micro-level of analysis that is typical of the dominant paradigm of information retrieval research.

APPENDIX: A NOTE ON FEEDBACK

Not all of the models presented above specifically include feedback [40] as an element, but it is clear that feedback loops must exist within all models, since progression towards a goal is hardly ever unproblematic. For example, a person at any of Kuhlthau's stages may have to revisit an earlier stage as a result of problems experienced or new information found and, in Ellis's model, a person engaged in, for example, extracting may, as a result, need to return to chaining or browsing to gather further information. Similarly, in Dervin's model, a person
moving from situation to outcome may, as a consequence of finding information, need to review the situation and proceed in a different way towards the outcome.

When feedback is explicitly introduced into models of information behaviour the process can be seen to require a model of the process that views behaviour as iterative, rather than one-off and the idea of successive search activities introduces new research questions.

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REFERENCES


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