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Toward an integrated model of information seeking and searching

ABSTRACT

The emphasis in much information seeking research at the current time is on the social and cultural context of human interaction with information. This effort is highly desirable, but is incomplete. The model to be developed here has integration as its objective in two senses: 1) to provide a single model that incorporates both information seeking and searching within it, and 2) to integrate the social and cultural with the underlying biological and physical anthropological layers of human experience with respect to information seeking and searching.

Introduction

In information studies currently, there is a burst of exciting work being done on information seeking in a social and cultural context. Indeed, that emphasis on context has been sufficiently important that an entire conference, namely, this one, has been dedicated over several years to studying information seeking in context. As a result of this interest, we have learned much about the rich social texture surrounding people and imbuing their information seeking. This research has added immensely to our understanding of information-related behavior by people, and I expect it to continue to do so, as more and more work along this line comes out.

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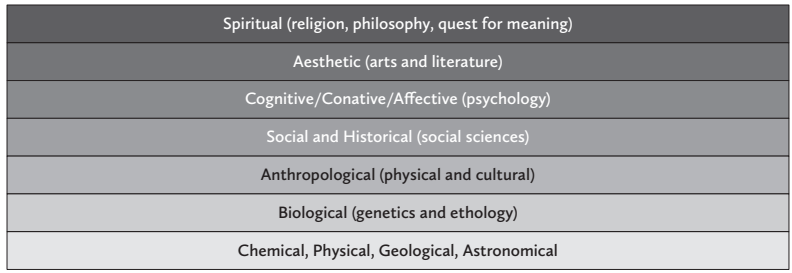

FIG. 1. *Levels of understanding*

However, I have been troubled by an apparent almost complete absence of awareness of and attention to a scientific perspective, as distinct from a social sciences or humanities perspective, on these information seeking questions in our field of late. See also the discussion in Sandstrom and Sandstrom (1995). Scientific approaches are frequently seen as inherently reductive, that is, they are assumed to be explanations that seek to reduce understanding of the social and spiritual in life to the merely physical. While there have long been, and probably always will be, people who attempt such a reduction, there are also many who do not, including myself. Studying something from a natural science point of view does not automatically mean that one is claiming that only the natural science matters or can teach us something. In my view, our understanding of information seeking is not complete as long as we exclude the biological and anthropological from our study. To focus only on the social and humanistic is simply to be reductionist in the other direction!

Surely, it is desirable to build our understanding of information seeking behavior on all the levels in Figure 1, not just some, whether upper levels or lower ones.

So the phrase, "integrated model," in the title has a dual meaning in this paper. I am attempting to 1) integrate our understanding of information seeking across the several levels, or layers, of human life, and 2) develop an integrated model of information seeking in relation to information searching.

The biological and anthropological levels

Because I believe that the biological and anthropological levels have been neglected in the study of information seeking, I will emphasize them here

FIG. 2. *Interpenetration of the levels*

today. But the intention is not to reduce information seeking in context to only these levels. Rather, I hope to re-introduce these levels to our thinking, and integrate them with the social levels.

This approach is best illustrated by Figure 2, "Interpenetration of the Levels." This diagram illustrates how the several levels are, in reality, often interpenetrating each other, and doing so in a variety of ways. For example, for a person with severe schizophrenia, the biological reaches all the way through all layers of life, and may impede the ability to operate effectively in life, to relate socially, and so on. In other cases, say, a high level of intelligence, or a propensity to migraine headaches, the biological may benefit or at least not harm too much the living at the other levels.

Other aspects of human life show complex interrelations between these several levels. For example, it is generally agreed in the field of psycholinguistics that human beings have some sort of in-born language capacity that puts some constraints on the nature of the languages that can be developed. Within those constraints, however, language can and does have the huge variety that real-world languages show. See Jackendoff (2002), Pinker (1995). Thus, the particulars of the language a person speaks, the grammar and vocabulary, must all be learned during an individual's lifetime, and vary tremendously from culture to culture. So language capacity is neither totally biological nor totally social, but a complex mixture of both. Many other aspects of human behavior could be described with similar complex mixes across the levels.

For this reason alone, the study of information seeking will never be complete until we integrate the social levels with the underlying ones. To ignore the latter is to be incomplete at best, and seriously distorting at worst. The best way I can demonstrate what I have in mind is to attempt to develop a model of information seeking and searching.

Information seeking and searching

So where does information seeking come into this general context of integrated levels? First of all, let us consider information seeking with respect to all the information that comes to a human being during a lifetime, not just in those moments when a person actively seeks information.

We, along with other mammals, are capable of learning a great deal during our lifetimes. We have very large, general-purpose brains, and so can adapt to a great range of environmental conditions and social arrangements. We have some general mental structures, as with the language example above, which enable us to learn various types of things, but the specifics of what we learn come with our experiences. We, also like most mammals, learn particularly much from family or clan. These are emotionally intense relationships—because our very survival depends on their succor—and so family learning makes a great impression. We are a very social species and draw much learning and experience from such social interactions. For most people, most of the time, information-related behavior consists of absorbing and using the learning and information that comes our way during the course of our daily lives.

Looking at us as a species that exists physically, biologically, socially, emotionally, and spiritually, it is not unreasonable to guess that we absorb perhaps 80 percent of all our knowledge through simply being aware, being conscious and sentient in our social context and physical environment.

With that as a foundation, let us consider Figure 3, "Modes of Information Seeking" (adapted from an earlier paper by the author [1986]). "Directed" and "Undirected" refer, respectively, to whether an individual seeks particular information that can be specified to some degree, or is more or less randomly exposing themselves to information. "Active" and "Passive" refer, respectively, to whether the individual does anything actively to acquire information, or is passively available to absorb information, but does not seek it out.

Awareness An enormous part of all we know and learn surely comes to us through passive undirected behavior, or simply *being aware* (cell "D" of Figure 3).

The work of Virginia Walter (1994), a colleague at UCLA, is illustrative of the value of the above perspective. The few studies of children's information seeking had mostly concentrated on instances where children seek information or books to read in libraries. But Walter saw that children had much larger needs—that even a two-year-old really has enormous information needs. She talked with people who work a lot with children, as children often cannot articulate their needs themselves, to discover what things children need to know at what ages.

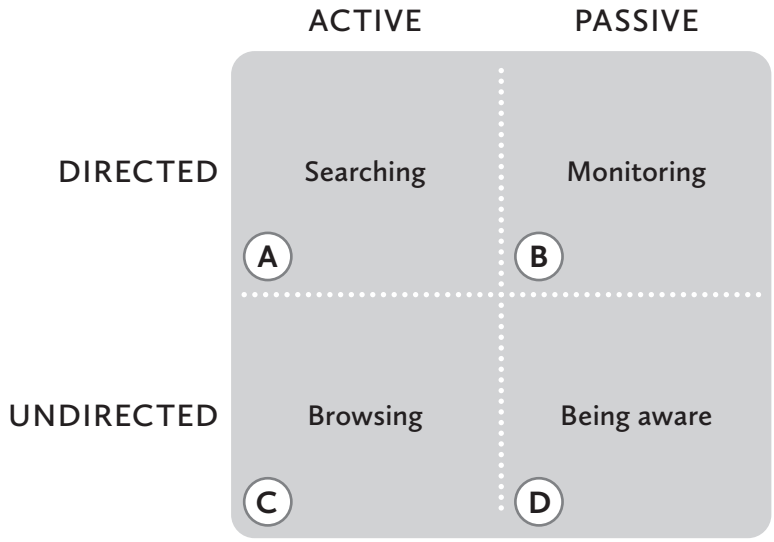

FIG. 3. *Modes of information seeking*

It is one thing to think of children's information needs as the questions they ask about dinosaurs when they go to the library. It is quite another to see the full array of learning that must occur for a child to emerge successfully into adulthood. In a dysfunctional family, with parents on drugs, for example, there may be no one to tell the child to look both ways when crossing the street—something as simple as that. The children of thieves think thievery is natural; it is what people do. That comes from simply soaking up what is in their environment, especially from the emotionally meaningful people around them.

In this context, then, when we determine what services to offer in the public library, we may have a substantially different view of the way in which that library can serve children. Specifically, the library can constitute not only a good education and entertainment resource for children, but also may constitute a critical additional venue for children to get essential life information that they are not getting anywhere else. We see here how a view of children in terms of the learning they must take in as offspring, in order to develop into successful adult members of the species, changes our perspective on what they need, and has immense implications for policy at the social level.

Monitoring Monitoring and browsing are complementary to each other, opposites, in a way. Monitoring is directed and passive, while browsing is

undirected and active. In monitoring (cell "B" of Figure 3), we maintain a back-of-the-mind alertness for things that interest us, and for answers to questions we have. We do not feel such a pressing need that we engage in an active effort to gather the information we are interested in; we are content to catch as it goes by, so to speak. We also may have a question in mind and not act to find an answer, but notice when information comes along that is relevant to the question. (The activity that has been called "maintaining current awareness" in the information seeking literature may use monitoring, directed searching or browsing.)

One of the things the information seeking in context research is teaching us is that, intentionally or unintentionally, we often arrange our physical and social environment so as to provide the information we need when we need it. From grocery lists to the arrangement of dials in airplane cockpits, to the physical placement of and organization of tools and offices, we make it possible to be reminded, when we need reminding, of next steps or appropriate behaviors. See Hutchins (1995), Sellen and Harper (2002), and Star and Ruhleder (1996) for examples of research into these sorts of contextual supports. The availability of these supports cuts down on the need for active information seeking. Here it is hard to draw a line between simple awareness and monitoring. Presumably, the more experienced one is with a particular action or process, the more likely one is to be monitoring the environments for the infrastructural triggers for the next behavior.

The elaborate social infrastructure of academic disciplines (Garvey, 1979; Wiberley & Jones, 1989; Bates, 1994), of hobbyist groups (Hartel, 2002), and of work groups (Hutchins, 1995; Star & Ruhleder, 1996) is very supportive of monitoring. A person is likely to come across a great deal of useful information just in the process of interacting socially and physically within the relevant milieu. In academic departments, scientific laboratories, as well as at conferences and over listservs, the typical participant in a discipline or work group continually runs into people who have a lot of common areas of knowledge, people who can suggest information or resources of use to the participant. See Menzel (1959) for excellent examples. These serendipitous encounters are not truly by chance, in the usual sense of the term. Rather, they are the product of proximity, either electronically or physically, that has come about through people organizing for common goals and needs.

Browsing Browsing is the complementary opposite of monitoring. Here we have no special information need or interest, but actively expose ourselves to possibly novel information (Figure 3, cell "C"). It can be said

that **monitoring** and **directed searching** are ways we find information that we know we need to know, and **browsing** and **being aware** are ways we find information that we do not know we need to know.

Curiosity may lead to browsing behavior. Curiosity poses an interesting dilemma for animals over the course of biological evolution. Curiosity *has* killed a few cats. See also discussion in Loewenstein (1994). Curiosity may lead to discovering new food sources or mates, but it can also lead an animal to unexpected dangers. It seems likely, then, that there is a trade-off, a balance between too much and too little curiosity in a species. We may presume that the amount of curiosity in a given species is approximately right for at least some of the conditions that that species evolved under.

It pays to examine closely the actual physical behavior engaged in by a browsing person. Barbara Kwasnik (1992), in work that has been too little recognized, identified the actual physical activities associated with browsing. She noted that people do not just scan the horizon in one single movement, but rather take a glimpse, look further at things that interest them, then take another glimpse, and so on. She identified actions within browsing, such as orientation, place-marking, comparison, resolution of anomalies, and so on. This is a complex behavior, charged with meaning. And it shows up in many human behaviors, not only in interaction with recorded information. See also discussion in Rice et al. (2001).

My doctoral advisee, Jenna Hartel, has been developing an approach to browsing in which she has identified a variety of behaviors that can all be seen as similar to browsing, that is, the same underlying impulse is translated into a generic behavior we call "sampling and selecting." Behaviors she has identified to date include browsing, berrypicking, mingling, dating, shopping, nibbling, sightseeing, wayfinding, channel surfing, and Web surfing.

In each of these cases, a person samples from a number of possibilities and then selects from among the options. In another paper, we are arguing that this sampling and selecting behavior may have evolved out of mating and foraging behavior. Indeed, some of the things on this list *are* mating and foraging!

Sandstrom (1994, 1999) and Pirolli and Card (1999) have written extensively on what they call "information foraging." It is a common pattern, recognized in evolutionary biology, that a feature adapted for one purpose in a species is used for another purpose when the environment puts different demands on the species. Gould and Vrba (1982) call this "exaptation."

We have no way to prove this, but it may be that foraging behavior has exapted to browsing or other information seeking behavior. We suspect

that, in the act of browsing, human beings have applied a general propensity to sample and select, evolved through millions of years, to sampling and selecting from information objects or sources.

Directed searching Finally, we come to directed search—active attempts to answer questions or develop understanding around a particular question or topic area (Figure 3, cell "A"). If being aware gives us 80 percent of all we know, then directed searching probably gives us one percent, with browsing and monitoring taking up the rest. Countless studies have shown that people use the principle of least effort in their information seeking, even to the point that they will accept information they know to be of lower quality (less reliable), if it is more readily available or easier to use. A large number of these studies are reviewed in Poole (1985).

We have long puzzled in this field over this human perverseness. Why do physicians not use the medical literature, rather than relying on the drug company salesperson for information about a new drug? Why will our students not get up and walk a hundred meters to access a key journal article in the library? Well, put in the context presented here, we can see that throughout human history, most of the information a person needed came to him or her without requiring active efforts to acquire it. Picture the hunter-gatherer: raised in a family group or clan, most learning came through interaction with one's mates and with the environment, that is, through being aware and monitoring. As one's clan moved around, looking for food, one would forage in new environments, that is, one would essentially browse for food, for materials for shelter, for possible mates, etc., wherever one happened to wander.

Once in a while, one would have a specific problem to be solved that required some information to answer. One would ask others, or try to discover an answer on one's own, through experiment or exploration. So, throughout human history, active searching for information has actually been a relatively rare act in most lives. Or, to put it differently, we get so much information through the natural conduct of our lives, from the flow of people and events around us, that it is easy to fall back on those rather passive habits, to expect that the needed information will just come along, rather than having to expend energy to acquire it.

Directed searching is further complicated by another factor in our modern lives. It has only been in the last 200 years or so that the amount of recorded information available has grown to such an extent that complex and sophisticated access mechanisms have had to be developed to enable access. So, people accustomed to mostly passive ways of learning new information not only have to search actively for the information, but also have to master a fair amount of ancillary skills and knowledge just to be

able to search for the information, with no guarantee that that effort will actually lead to an answer.

Put in this way, I think we can see why the overwhelming propensity of most people is to invest as absolutely little effort into information seeking as they possibly can. It is only in moments of great urgency or great interest that they spontaneously begin investing seriously in acquiring the information skills needed to satisfy their needs.

Information farming

Sandstrom's research showed that, not surprisingly, people sought to reduce their information seeking effort (Sandstrom, 1999). However, her foraging model makes it possible to explain effort reduction more fully than we have otherwise been able to do to date. She found that "such searching behaviors as regular reading, browsing or the deliberate information foray (relatively solitary information-seeking activities) yielded resources belonging mostly to the peripheral zones of scholars' information environments" (p. 19). She found that core resources, by contrast, were often resident in the scholar's own personal collection, or came through colleagues, article reviewing, and other socially mediated channels.

Put in the terms used earlier in this article, much information comes through the social milieu one works in—just as it came in hunter-gatherer times through the family or clan, and much of the rest comes from personal collections. It is only rarely that the scholar forages alone into truly new territory.

However, hunter-gatherers have no "personal collections." In their case, life is lived in a nomadic manner, and collections of objects cannot realistically be carried along. Collecting things did not really begin until nomadic peoples became sedentary, that is, began farming (Harris & Hillman, 1989).

The items one collects personally can be seen in analogy to farming, because the scholar "tends" the farm by organizing the materials for later use. Whether the resources are simply sorted in meaningful piles on a desk, or filed in various systems of organization, the scholar typically creates and exploits a system of organization for personally owned materials. This process is called "enrichment" by Pirolli and Card (1999). Also compare Case (1991a, 1991b), Soper (1976), and Sellen and Harper (2002). Sandstrom was studying researchers, but there are many examples of people in other walks of life and in pursuit of hobbies who collect a great deal of information and organize it for their continuing uses.

The integrated model

The four-part model of awareness, monitoring, browsing, and searching in Figure 3 may be seen to incorporate both information seeking in general, as well as explicit acts of information searching; in other words, it may be seen as an integrated view of information seeking and searching.

The two passive modes of information seeking—awareness and monitoring—almost certainly provide the vast majority of information for most people during their lives. The child soaks up what is in its environment, and even adults, who have full freedom of movement, often rely almost entirely on whatever information comes their way socially and culturally in order to solve life or work problems. As Sandstrom noted, much information comes to the scholar through the social structures within which the scholar is embedded—service on editorial boards, graduate training, discussion with colleagues (Sandstrom, 1999, p. 19).

In the model, active information seeking occurs with the other two methods of browsing and directed searching. In both of these cases, it appears that a fundamental behavior, which Hartel and I call "sampling and selecting," has likely been exapted from mating and foraging behaviors to the more socially and cognitively sophisticated human behavior of information seeking. I suggested in 1989 (Bates, 1989) that what I called "berrypicking"—which I would now see as one more manifestation of sampling and selecting—was the more common and natural way people actually engaged in active directed searching. I argued against formalistic models in which the searcher submitted a query to an information system and the system found what the searcher wanted. Rather, I suggested, the searcher typically finds information a bit at a time, uses a variety of sources—diet breadth, in the parlance of foraging theory (Pirolli & Card, 1999)—and a variety of search methods to find everything wanted, i.e., engages in berrypicking.

In the more comprehensive context of both this four-part model and of the concept of "sampling and selecting," it can be seen that both browsing and berrypicking are types of sampling and selecting. Browsing is undirected, while berrypicking is more directed. In fact, one could argue that berrypicking is the natural mode for doing all directed searching, though, for one reason or other, not everyone is able to engage in berrypicking to solve directed search needs. So, left to their own devices, most people resort to sampling and selecting techniques for both directed (berrypicking) and undirected (browsing) active information searching.

Thus, in terms of information seeking as behavior, people operate in two general modes—sampling and selecting (Figure 3, "A," "C") or passive absorption ("B," "D"). When they know what information they want, people

generally either actively search for it (A), or monitor environmental information for it (B). When they do not know what they want, people browse (C) or remain passively aware (D). Thus the natural propensities of human beings are to collect information passively through absorption from the environment or actively through sampling and selecting.

The role of the social structure of information access

Let us suppose, then, that the natural predilection of most people is to fall back on passive absorption or sampling and selecting as a way to find needed information. What happens when this propensity encounters the complex structures of libraries, classifications, metadata, and so on? It was not until approximately the late eighteenth or early nineteenth century that the quantity of publications available became so large that libraries began to have to find more powerful means of access to the contents of book and other collections. Before then, the knowledgeable librarian or scholar often knew of all the relevant materials for a given research interest.

However, in the modern industrial world, when more powerful methods of printing and distribution were developed, it became possible for libraries to collect far larger numbers of items than had been dreamed of before. More effective access became a pressing need, and all the systems developed in the nineteenth and twentieth centuries—classified and alphabetico-specific catalogs, subject headings and thesaurus terms, online database searching and the World Wide Web—constituted efforts to make a small slice of information accessible within ever-larger enveloping collections.

An enormous amount of energy has gone into the design and application of these various systems—yet the information seeking literature continues to show that people avoid or ignore these monumental access systems to a great extent—even people with doctorates, who we would expect to be very skilled in information searching. With the biological/anthropological approach taken in this paper, perhaps we can now see this human propensity in the following way: The natural human tendency in information seeking is to fall back on passive and sampling and selecting behaviors derived from millions of years of evolutionary development. Information seeking has thus generally been done in a rather unconscious or automatic way. To put it differently, passive absorption and sampling and selecting have been around so long that they are carried out in a completely natural, unselfconscious way.

On the other hand, complex intellectual systems of access are only a century or two old, at most. To use them effectively, they require that

the searcher master quite a bit of both substantive knowledge about the systems of access, as well as technical searching skills, known as "declarative" and "procedural" knowledge, respectively (Bhavnani & Bates, 2002). As people are generally quite unaware of their usual information seeking behaviors, they do not even have as a part of their conscious thought the idea that one needs searching skills and search planning—let alone know of specific strategies they can follow to find what they want. In that case, it is not surprising, then, that the methods of access designed by librarians are generally little used.

Perhaps, finally, this biological/anthropological perspective on information seeking can go some way in explaining the persistent results we find in studies of information seeking and searching. People use least effort because they have always used it, and because, until very recently, it has worked adequately, if not optimally.

Integrated model redux

I have endeavored to provide an example in which some of the levels in Figure 1 are at least partially integrated in our thinking about the information seeking and searching of human beings. I would like now to return to the philosophical question of how these levels should properly be integrated. How we do so can be interpreted in many ways. Briefly, I would like to compare this approach to those of two other papers presented recently, which also discuss types of integrated models—those of Tuominen, Talja, and Savolainen (2002), on the one hand, and of Hjørland (2002) on the other hand.

In their 2002 conference article entitled "Discourse, cognition, and reality. . .," Tuominen, Talja, and Savolainen discuss three metatheories, which they term the "information transfer" model, the constructivist model, and the constructionist model. To put it in simplistic, but not seriously distorting terms, they equate the first model with a classically scientific approach, the second with a cognitivist approach in which the individual experiencing person is the focus of attention, and the third with the socially and linguistically negotiated production of knowledge and discourse communities. They see the three theories as following upon each other in time, each constituting a "correction" of the prior ones (Tuominen, Talja, & Savolainen, p. 279). They argue for the third, and most recent, in this series, constructionism, as being superior, and as a good metatheory upon which to base present library and information science research. We could thus say that they are writing within a historical

perspective, in which each new metatheoretical development improves upon and enriches the prior metatheory. Thus, the scientific approach of the "information transfer" model is passé, retro—good in its time, to be sure, but now superseded twice over by successive superior metatheories, cognitivism and then constructionism.

Hjørland, on the other hand, takes a different strategy. In his 2002 paper, "Epistemology and the socio-cognitive perspective in information science" (Hjørland, 2002), he contrasts the cognitive metatheory with the socio-cognitive, or, "domain-analytic" metatheory. As he says, "In domain analysis, we are less inclined to speak about mental models and more inclined to talk about knowledge, (pre)understanding, theories, paradigms, and epistemologies" (Hjørland, 2002, p. 261). He argues for the latter approach, just as do Tuominen et al. (2002).

Hjørland astutely points out that:

> The cognitive view tends to psychologize the epistemological issues (to study knowledge by studying the individual), but what is needed is the socio-cognitive view, which tends to epistemologize psychological issues (to see individual knowledge in a historical, cultural, and social perspective). (p. 268)

Let us examine the logical and rhetorical strategies used in these two articles. Tuominen et al. argue that constructionism has grown up as a correction, and by implication, a clear improvement on, prior scientific and cognitivist metatheories. Hjørland, on the other hand, argues that the cognitive view has psychologized epistemological questions, that this is wrong, and that what is needed now is a socio-cognitive metatheory that epistemologizes psychological issues. In other words, in our field, epistemology should lead and dominate psychology.

I want to take a third logical and rhetorical position. The scientific, the cognitive, and the socially constructed metatheories need not struggle for dominance. The epistemological issues should not be psychologized and the psychological issues should not be epistemologized. Nor should these metatheories be viewed in a solely historical context, in which whatever came earlier is automatically inferior. The very fact that we have at some point in human history, explored and learned much that is meaningful from these various metatheoretical perspectives should suggest that there may be a *valuable continuing role for all of them.*

Each of these three perspectives, as well as the several others referred to in Figure 1, constitute distinctive types of learning, research, and understanding that human beings have developed over the course of our

history. The paradigms of the various disciplines, as well as the range of distinctive sub-paradigms that develop within these disciplines over time, represent human explorations in mind, in the social world, and in nature. Each of these distinctive intellectual perspectives constitutes a wonderfully enriching means of understanding human experience.

Not infrequently, different philosophical perspectives and metatheories lie behind the understanding at each level. I would venture to say that the typical physicist has a different kind of mind, a different cognitive style, from the psychologist, and the psychologist a different one from the literary scholar. These differences are developed and sharpened through decades of study and intellectual development in individuals and in whole intellectual communities and disciplines.

We should not be surprised, therefore, if we find conflicts between these perspectives. I would argue, however, that we should address the conflicts directly through a dialogue leading to mutual understanding, rather than through an approach that seeks to enforce the triumph of one metatheory over another.

Conclusions

In this article, it has been argued that a more complete understanding of information seeking behavior requires attention to the several levels of human existence, not only to the social or individual perspectives. Biological and anthropological levels have been discussed in relation to previously known social behaviors of human beings with regard to information seeking.

Information seeking has been conceptualized in terms of all the ways in which information comes to people, including much that is absorbed passively. It has been argued that more active efforts to acquire information, such as browsing and berrypicking, are probably applications of a generic human behavior known as sampling and selecting. Sampling and selecting, in turn, may be an exaptation (though I cannot prove it) from original animal food foraging and mating behavior.

Searching thus becomes one behavior within a general model of human information-related behaviors (see Figure 3). Human tendencies to use the principle of least effort, and more generally, to be quite passive in information seeking, may come about because so much needed information has come automatically from the social milieux of most people throughout the history of humanity.

Finally, it has been argued that the several metatheories driving research in information seeking each have much of value to offer, and should not be placed in a life or death struggle for dominance in our thinking and research.

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