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# Introduction to Information Science and Technology

Edited by Charles H. Davis and Debora Shaw

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## Introduction to Information Science and Technology

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## Information Needs, Seeking, and Use

### 3.1. Information Behavior

Information behavior research is part of the behavioral sciences and may be associated with the highly criticized behaviorist approach. Jerome Bruner (1990) suggested using the term *human acts*, rather than *human behavior*, to indicate the focus on meaningful rather than mechanical activities. The use of *actions* and *activities* also connects with the core concepts of *activity theory*. We might thus speak of *human information acts* rather than of *human information behavior*. However, because *information behavior* is still the most frequent term, we continue to use it.

Information behavior covers not only the active seeking of information but also a much wider range of activities. For example, an accidental encounter with information that was not sought and someone's attempt to avoid information are instances of information behavior. The term came into use as scholars moved away from an earlier focus on *library use and user studies*, which emphasized institutional sources and searches, to a broader investigation of how individuals encounter and make sense of their environments. Thus, information behavior encompasses information seeking, unintentional or passive behaviors (such as glimpsing or encountering information), and purposive behaviors that do not involve seeking, such as actively avoiding information. Whittaker (2011) extends the coverage to individuals' information *curator* practices—decisions about what to keep and how to find it.

Many theories and concepts are of potential relevance to research on information behavior; Fisher, Erdelez, and McKechnie (2005) briefly introduce 72 of them. Bates (2002) identified four modes of information acquisition (which she termed *information seeking*; see Figure 3.1).

When taking directed action, an individual seeks particular information that can be specified to some degree; the "undirected" seeker is more or less randomly exposing himself or herself to information. When active, the individual does something actively to acquire information; when passive, the individual is passively available to absorb information but does not seek it out. Bates (2002) contended that we humans absorb as much as 80 percent of our knowledge simply by "being aware" (Figure 3.1, cell d). Bates (2002) also pointed out that "browsing is the complementary opposite of monitoring,

	Active	Passive
Directed	Searching (a)	Monitoring (b)
Undirected	Browsing (c)	Being Aware (d)

Figure 3.1 Modes of information acquisition (Bates, 2002)

Here we have no special information need or interest, but actively expose ourselves to possibly novel information. ... 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" (first paragraph under "Browsing").

Case (2007) concluded his extensive review of the research and thinking on information behavior with eight lessons of information behavior research:

1. Formal sources and rationalized searches reflect only one side of human information behavior.
2. More information is not always better.
3. Context is central to the transfer of information.
4. Sometimes information—particularly generalized packages of information—doesn't help.
5. Sometimes it is not possible to make information available or accessible.
6. Information seeking is a dynamic process.
7. Information seeking is not always about a problem or problematic situation.
8. Information seeking is not always about *sense-making* either. (pp. 326–328)

### Explaining Information Behavior: Activity Theory

Activity theory provides a good overall framework for considering information behavior. Wilson (2006) noted that activity theory is a conceptual framework, not a predictive theory, and thus allows researchers to use different theoretical perspectives. Typically, activity theory researchers employ

multiple methods of data collection and extend their investigations for a long enough time that (nearly) all contextual issues can emerge.

Activity theory can provide a holistic view of information practices in which the individual subjects and their collective relationships, the objects used, and the tools or technology employed are treated as equally important and in which situated and historical context is taken seriously. Activity theory stresses the development of cognition as a unity of biological development, cultural development, and individual development. It has a strong ecological and functional-historical orientation. It focuses on the activity of the subject and the object orientation of this activity. Hjørland (1997) noted that activity theory "stresses the ecological and social nature of meaning. ... A person's use of a term may be determined not by his individual usage, but by the usage of some social group to which he semantically defers. Therefore, the content of a person's thoughts are themselves in part a matter of social facts" (p. 81).

### Information Encountering and Information Avoidance

Information seeking is the most frequently studied information behavior; it is discussed below. Two other information behaviors merit brief comment: *information encountering* and *information avoidance*.

Information encountering is the "memorable experience of an unexpected discovery of useful or interesting information" (Erdelez, 1999). According to Erdelez, most people have some experiences of information encountering, although some "nonencounterers" have difficulty recalling any such experience. A small number of individuals are "super-encounterers," who rely on information encountering as a primary method for finding information even though they are aware that it is not the standard way to locate information one needs. Most people are "encounterers" or "occasional encounterers," who report that they frequently come across information while pursuing other tasks; libraries, bookstores, and the internet are often sites where information is encountered. Erdelez's super-encounterers reported that they found the amount of information on the internet overwhelming and they therefore tended not to use it.

Information avoidance has long been the subject of study in the fields of psychology and communication. As Case, Andrews, Johnson, and Allard (2005) have noted, "Sometimes people avoid information, if paying attention to it will cause mental discomfort or dissonance" (p. 354). Particularly with health-related information, researchers observe that some people adopt a *monitoring* approach—seeking additional information—but others use *blunting* strategies to ignore information or distract themselves from the problem. Case and colleagues noted that most models of information seeking assume that people want to find information and reduce their uncertainty; however, for some people and in some situations, information

avoidance may be preferable, and additional information may actually increase uncertainty.

### 3.2. Information Needs

The concept of *information need(s)* (or *user need(s)*) comes from the field of library and information science. Miksa (2009) traced interest in users and their information needs back to the beginning of printing, with more attention in the 19th century as the library became the source of "mental cultivation" (p. 353) for not only the scholarly and well bred but the general population as well. The current understanding of information needs emerged as the field began to focus on empirical investigations of the use of library and information services. In this context, an information need arises when a person needs information in order to accomplish a goal; the library or an information system exists to fulfill users' and potential users' needs for documents and information. These needs may be related to educational, research, professional, recreational, or cultural activities, or to personal development.

An information need may be recognized or unconscious, and people may disagree about information needs: A student's perception and experience of an information need related to an assignment may differ from the teacher's understanding. Information need should be differentiated from *information demand*. For example, the demand for information or documents may be low if potential users see a library as inaccessible or unapproachable; still, the *needs* exist. Information needs may also exist in cases in which the individual remains ignorant of the need and thus cannot express it; for example, a student preparing a report may be unaware of useful information and therefore not request it.

Taylor (1968) presented one of the first analyses of information need, which he viewed as developing internally in the person seeking information. The information need develops from 1) an unexpressed, "visceral information need" to 2) a "conscious need" that can be expressed (often to a colleague), to 3) a "formalized need" that presents a more complete statement, and to 4) a "compromised need" that the information seeker has adapted to what he or she perceives the information system can handle.

Hjørland (1997) criticized Taylor's model because it views information needs as internal motivational states (a psychological condition) rather than lack of subject knowledge. What users *believe* they need is represented by their subjective understanding of their situations. This subjective understanding is reflected in their information seeking. Resolving the problem underlying users' information-seeking behaviors involves subject expertise at least as much as psychological knowledge.

Belkin (2005) proposed that information retrieval systems should be designed to consider and support the user's information need as it evolves during a search. Drawing on cognitive and communication perspectives, he described this need as an *anomalous state of knowledge*. The *anomaly* indicates that the user's state of knowledge is inadequate to resolve a particular problematic situation. The inadequacy might result from lack of knowledge or uncertainty regarding which concept would be appropriate in the situation.

### Kinds of Information Needs

Information needs may be classified to reflect the kinds of information services that are relevant in relation to different situations:

- *Procedural information needs* concern how to do things: What do you need to know in order to bake a cake? to repair a car? to measure a melting point? to write a thesis? These kinds of needs may be partly satisfied by "how to" documents (or cookbooks).
- *Substantive information needs* relate to subject knowledge; for example, what is the atomic number of carbon or what were the causes of the Black Death? Such needs are often connected with scientific and scholarly research literature. Scholarship is developed through discourses (based on assumptions) about how to discover the truth or how to produce useful knowledge. Satisfying substantive information needs thus entails judgments about what constitutes authoritative information sources.
- *Muddled information needs* may occur, as when, for example, a user lacks subject knowledge and therefore is not in a position to formulate a precise question. Swanson (1986) posed the example of a search for mathematical analysis of how a child "pumps" a swing. The information cannot be found under *pumping* or *swings*, but in the literature on *parametric amplifiers*. Information needs may also be muddled, however, because a research field is without consensus—it is muddled itself. Theoretical improvement of the field is required.
- *Verificative information needs* seek evidence or confirmation. Some request bibliographic verification of sources that a writer plans to discuss. Library services and bibliographic databases have tools to deal with this kind of information need. Scientists also have verificative information needs for empirical data that confirm or weaken existing claims.
- *Educational information needs* occur when useful information exists, but the person in need is unable to understand it. Such

3. *Browsing*: Semi-directed searching in an area of potential interest
4. *Differentiating*: Using differences between sources as a filter on the nature and quality of the material examined
5. *Monitoring*: Maintaining awareness of developments in a field through the monitoring of particular sources
6. *Extracting*: Systematically working through a particular source to locate material of interest (pp. 138–139)

Subsequent studies of humanities scholars, scientists, and engineers added seven more behaviors (Ellis, 2005):

1. *Surveying*: Familiarization with the literature of the area
2. *Verifying*: Checking that information is correct
3. *Selecting and shifting*: Deciding which references to follow up and which to cite
4. *Distinguishing*: Ranking information sources according to their perceived relative importance
5. *Filtering*: Use of criteria or mechanisms to make the information as relevant or precise as possible
6. *Assembling and disseminating*: Drawing together material for publication and dissemination
7. *Ending*: Information seeking at the end of a project (pp. 139–140)

### Kuhlthau's Information Search Process

Carol Kuhlthau's model was initially developed in the 1980s and refined in the 1990s; it has been used in several empirical studies. Kuhlthau's model deals with six stages of the information search process and describes the information seeker's feelings, thoughts, and actions at each stage. It may be helpful to think about how students find information for a term paper, which was one of the areas first studied with this model (Kuhlthau, 2005):

- *Initiation*: A person becomes aware of a lack of knowledge or understanding, making uncertainty and apprehension common.
- *Selection*: A general area, topic, or problem is identified, and initial uncertainty often gives way to a brief sense of optimism and a readiness to begin the search.
- *Exploration*: Inconsistent, incompatible information is encountered, and uncertainty, confusion, and doubt frequently increase.

- *Formulation*: A focused perspective is formed, and uncertainty diminishes as confidence begins to increase.
- *Collection*: Information pertinent to the focused perspective is gathered, and uncertainty subsides as interest and involvement in the project increase.
- *Presentation*: The search is completed, with a new understanding enabling the person to explain his or her learning to others or in some way to put the learning to use.

### Dervin's Sense-Making

Brenda Dervin's (1999) approach, although not strictly a model, provides a useful perspective on how interpretative or naturalistic research methods can be used to study information seeking (Case, 2007). Dervin criticized approaches that view information as an objective entity that exists apart from humans; she holds that information is not a brick that can be used to fill human "buckets" needing information. Instead, individuals construct information as they face gaps in their understanding of the world. Gaps occur in situations that are unique to the individual; bridging these gaps requires the individual to *construct* information, to make sense of the situation. Different people will perceive gaps (and bridges) differently. Research using this paradigm tends to focus on emotional (affective) perspectives as well as cognitive concerns.

### Wilson's Model of Information Behavior

T. D. Wilson's model of information behavior has evolved since the early 1970s. Later Wilson (1981) distinguished among physiological, affective (emotional), and cognitive needs that might cause a person to seek information. Wilson also made a point of distinguishing the "person-in-context" (Wilson, 2005, p. 34) to emphasize the impact on the information seeker of the work role and the environment (physical, political, economic, social, and cultural). In the most recent model (Wilson, 1997), an information need arises for a person-in-context (role, environment), an activating mechanism prompts the decision to seek information, intervening variables (psychological, demographic, role-related interpersonal, environmental) affect the decision, and source characteristics come into play. The decision to search information resources is influenced by assessments such as self-efficacy and risk versus reward. Then information seeking occurs and may involve passive attention, passive search, active search, and ongoing search. Information is processed and used, affecting the person-in-context.

### Summarizing Models of Information Seeking

A general view of information seeking emerges as more models are developed. In many cases information seeking involves a sequence of steps that can account for differences among information seekers. This can be presented via a model that is sufficiently general to explain information seeking in various situations.

A review of eight models of information seeking, including those discussed above, reveals that information seeking involves 11 types of variables:

1. Demographic characteristics
2. Personal experience and knowledge
3. Information needs
4. Thoughts (cognition)
5. Feelings
6. Criteria for source evaluations
7. Actions and queries
8. Information sources
9. Outcomes
10. Contexts (including barriers)
11. Criteria for evaluating information sources

### 3.4. Information and Digital Literacies

Information literacy, digital literacy, and similar concepts are frameworks for understanding and promoting effective use of information. *Information literacy* has been the more widely used term, particularly in school and college library contexts, since the 1980s. *Digital literacy* has gained popularity since about 2005. Numerous other information-related "literacies"—computer literacy, library literacy, media literacy, internet literacy, and so on—have also been suggested.

#### Information Literacy

Information literacy traces back to libraries' interest in *bibliographic instruction*, later known as *user education*. Grassian (2004) notes that bibliographic instruction is based in the physical library and is tool based, focuses on the mechanics of using those tools, and is tied to course assignments. Information literacy, however, has no physical constraints, is concept-based,

helps people learn how to learn, and supports learning outcomes of academic programs. The American Library Association and Association for College and Research Libraries (2000) have adopted standards for information literacy:

1. The information literate student determines the nature and extent of the information needed.
2. The information literate student accesses needed information effectively and efficiently.
3. The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.
4. The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.
5. The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.

UNESCO (2005) describes information literacy as an important tool for national and international development: It "is crucial to the competitive advantage of individuals, enterprises (especially small and medium enterprises), regions and nations; [and] provides the key to effective access, use and creation of content to support economic development, education, health and human services, and all other aspects of contemporary societies." Moreover, information literacy "extends beyond current technologies to encompass learning, critical thinking and interpretative skills across professional boundaries and empowers individuals and communities." UNESCO's Information for All Programme defines information literacy as people's ability to:

1. Recognize ... their information needs.
2. Locate and evaluate the quality of information.
3. Store and retrieve information.
4. Make effective and ethical use of information.
5. Apply information to create and communicate knowledge (Catts & Lau, 2008, p. 7)

Information literacy focuses on understanding one's information needs, being able to find and evaluate relevant information, and using that information appropriately. The American Library Association and the Association

for College and Research Libraries (2000) note, "Information literacy is related to information technology skills, but has broader implications for the individual, the educational system, and for society. Information technology skills enable an individual to use computers, software applications, databases, and other technologies to achieve a wide variety of academic, work-related, and personal goals. Information literate individuals necessarily develop some technology skills. Information literacy, while showing significant overlap with information technology skills, is a distinct and broader area of competence" (p. 3).

### Digital Literacy

The term *digital literacy* was used in the 1980s, generally to mean the ability to deal with hypertextual information (in the sense of computer-supported, non-sequential reading) (Bawden, 2001). Gilster (1997) expanded the concept of digital literacy in his book of the same name. Rather than a set of skills, competencies, or attitudes, Gilster viewed digital literacy as an ability to understand and use information from a variety of digital sources—it is simply literacy in the digital age: the ability to read, write, and otherwise deal with information using the technologies and formats of the time. Other authors have used *digital literacy* to denote a broad concept linking together other relevant literacies and those based on communication technology competencies and skills, but they have focused on "softer" skills of information evaluation and knowledge assembly, together with a set of understandings and attitudes (Bawden, 2008; Martin, 2006, 2008).

In summary, we can say that digital literacy is the set of attitudes, understandings, and skills to handle and communicate information and knowledge effectively in a variety of media and formats. Some definitions include *communicating*, those with a records management perspective mention *deleting and preserving*. Sometimes the resolution is sharper, with *finding* broken down into subprocesses such as *choosing a source*, *retrieving*, and *accessing*. In an age when information comes mainly in digital form, digital literacy would seem essential; however, it must be adopted with the caveat that an important part of digital literacy is knowing when to use a nondigital source.

Digital literacy in this sense is a framework for integrating various other literacies and skill sets, although it does not need to encompass them all, as Martin (2006) put it, we do not need "one literacy to rule them all" (p. 18). Although it might be possible to produce lists of the components of digital literacy and show how they fit together, it is not sensible to try to reduce it to a finite number of linear stages. Nor is it sensible to suggest that one specific model of digital literacy will be appropriate for all people, or indeed for one person over a lifetime. Updating of understanding and competence will be

necessary as individual circumstances change and as changes in the digital information environment bring the need for a fresh understanding and new competencies.

With these caveats, we can set out four components of digital literacy, as agreed to by most authorities in the field, in this way (Bawden, 2008):

1. Underpinnings
  - Literacy per se
  - Computer, information, and communication technology literacy

These underpinnings reflect the rather traditional skills, of which computer literacy is now one, that make up an older idea of literacy and an ability to function in society. Whether they should be regarded as a part of digital literacy proper or should be assumed, before digital literacy is grafted on, may be debatable. They are increasingly regarded as simply literacy in educational settings, or under headings such as *smart working* or *basic skills* in the workplace (Robinson, 2005).

These are the kind of basic skills needed to develop effective handling of information and knowledge. If traditional literacy is lacking, then however good the information technology skills, information will not be handled well. On the other hand, information and communication technology literacy is essential in dealing with the varied communication channels available to everyone.

2. Background knowledge
  - The world of information
  - The nature of information resources

This kind of knowledge was assumed for any educated person in the days when information came in books, newspapers, magazines, academic journals, professional reports, and not much else and was largely accessed through physical print-on-paper libraries. The well-understood publication chain—from author to archivist, passing through editors, publishers, book-sellers, librarians, and the rest—lasted as a sensible concept well into the computer age. Now it seems outdated, and there is no clear model to replace it. Nonetheless, gaining as good an understanding as possible of what the new forms of information are and where they fit into the world of digital information has to be an essential start in being digitally literate.

3. Central competencies
  - Comprehension of digital and non-digital formats
  - Creation and communication of digital information

- Evaluation of information
- Knowledge assembly
- Information literacy
- Media literacy

These are the skills and competencies, building on the basic underpinnings, without which any claim to digital literacy has to be regarded skeptically. They are remarkably wide-ranging, and it would be sobering to try to assess to what degree they are possessed in the various countries of the world.

#### 4. Attitudes and perspectives

- Independent learning
- Moral and social literacy

These attitudes and perspectives are perhaps what create the link between the new concept of digital literacy and an older idea of literacy, in vogue more than 200 years ago. It is not enough to have skills and competencies; they must be grounded in some moral framework, strongly associated with being an educated, or as our ancestors would have said, a "lettered" person. Of all the components of digital literacy, a moral framework may be the most difficult to teach or inculcate, but it comes closest to living up to the meaning of information in its Latin root *informare*—the transforming, structuring force.

Independent learning and moral and social literacy are the qualities attributed to a person with the motivation and mind-set to make best use of information. They provide the basis for understanding the importance of information and of "right dealing" with information resources and communication channels, as well as the incentive to continue to improve one's capabilities.

Taken together, these four components may seem to present a very ambitious set of competencies and attitudes to demand of anyone. Yet they seem to be what is needed to cope and to succeed in today's information environment. In particular, this form of digital literacy is a powerful aid in avoiding a number of the problems and paradoxes of information behavior—information overload, information anxiety, information avoidance, and the like (Bawden & Robinson, 2009).

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### 4.1. What Is Representation of Information?

Working with even a modest collection of information sources—books you have enjoyed reading or pictures from your vacations over the past 5 years—often involves storing, retrieving, and organizing more pieces of information than the human memory can handle without assistance. *Representation* is the first step in providing support: The representation is commonly a shorter word, phrase, or image that brings to mind, stands for, or typifies the book, picture, or other source of information. For example, a nation's flag may represent that country's language version of a website; it may also represent your pictures from a vacation in that country.

After the collected information sources have been represented, they can be arranged or ordered so that it is easier to find a particular item in the collection. Tools to make the organization of information useful to many people include classification schemes (e.g., those used in a library), indexes (such as in the back of a book), and catalogs (in libraries or online retailers). Both representation and organization are fundamental to providing access to information. Information organization is discussed in Chapter 5.

### 4.2. Words and Meaning: Semantics

#### On the Origins of Language

Whether language is something we invented or something innate to humans is still being debated. Chomsky (1957) promoted the theory that humans have an innate ability to develop and use language. However, evidence of similar abilities is emerging for chimps, gorillas, and aquatic mammals that also have large brains.

It seems reasonable to assume that early human interaction involved gesturing and pointing, followed first by some kind of vocalization and then by a progression from visual mimesis to iconic representations of the external world. In ancient Egypt, hieroglyphs (pictographs) were followed by hieratic (priestly) and demotic (popular) writing, illustrating a progression from affairs of religion and state to a more practical form of expression that facilitated commerce. In the ancient Mesopotamian valley (Babylonia and