III Conceptual Traditions in Human Information Behavior

Human information behavior (HIB) is one of the most active research areas in library and information science (LIS). Since it became a recognized research field in the early 1960s, it has grown by leaps and bounds. A testimony to this growth is the number of documents covered in review articles about the area in the *Annual Review of Information Science and Technology* (*ARIST*). Whereas the first review (Menzel 1966) covered 23 documents, the fifth review (Lipetz 1970) covered 114 documents, most of which had been published in the previous year. The last review—titled "Information Behavior" (Fisher and Julien 2009)—was selective rather than inclusive and covered over 240 documents, excluding papers "that limited themselves to the use of a particular source or system, did not encompass broader concepts or principles, and [belonged to] other information subfields such as information retrieval, information literacy, and knowledge management" (317). Tom Wilson (1994) indicated that between the mid-1960s and the beginning of the 1990s, LIS literature included reports on several thousand HIB studies (15).

The rapid growth of the field is also reflected in the titles of the review articles in HIB. Until the 1990s the area was called *information needs and uses* by American scholars, who also used the phrase *user studies* to refer to empirical research projects.[1] The reviews that followed were much more specific. Some of them focused on a particular community of actors, such as managers (e.g., Katzer and Fletcher 1992; Choo and Auster 1993), or on the search and use of a specific type of sources, such as scholarly publications (e.g., King and Tenopir 1999). Others were dedicated to specific topics within the field, such as the browsing strategy (e.g., Chang and Rice 1993), task-based information-seeking (e.g., Vakkari 2003), context in information behavior research (e.g., Courtright 2007), collaborative information-seeking (Foster 2006), and design of an interface for information-seeking (Marchionini and Komlodi 1998). Some articles even found enough documents to complete a review about the methods and methodologies in HIB (e.g., Wang 1999; T. D. Wilson 2008).

Following the methodological and conceptual shifts in the social sciences, HIB research has experienced transitions of its own. In addition to its expansion, research standards have shifted with regard to four interrelated, basic methodological concepts:

- *Generalizability* has changed its status as the most important value of a study's findings. Other criteria were established and a research project is also valued according to its contributions to theory and practice, regardless of the level of its generality.
- The nature of the *expected results* has expanded to include not only "facts" (or knowledge claims), but also ideas and insights.
- The status of *variables* as the main (and at times the only) center of an investigation has been altered as researchers studied phenomena to understand them without focusing on their variability.
- Scholars have recognized the significant role of *context*, which is specific and particular to the studied phenomenon, and have included it in studies.

The concepts' transformation is commonly recognized as a shift from a system-centered approach to a user-centered one. This transformation created a distinction between two generations of research (the topic of chapter 6) and supported the growing interest in in-context research (see chapter 7). These shifts were gradual and were supported by relatively new theoretical traditions that have been developed in the social sciences. Moreover, the four major concepts are strongly shaped by the theoretical traditions researchers are following, whether or not the researchers are cognizant of the tradition they follow. The transition to a user-centered approach is still far from being complete.

6 Two Generations of Research

Human information behavior (HIB) made its first steps as a scholarly area in the early 1960s. Typical of an emerging field, it has undergone several transformations since then, the most noticeable of which was the shift from the first research generation to the second. First-generation projects typically focused on a defined group of users searching a context-specific system, and employed statistical analyses to uncover correlations among variables, primarily for the purpose of improving the information system and services at hand. In contrast, many projects in the second generation sought patterns of user behavior—some general and others specific—hoping to contribute in a variety of ways.

The two generations can be differentiated along various characteristics. From the methodological view, it is useful to examine two of the threads in research that made the difference: (1) the level of *generalizability* to which the field aspired, and (2) the nature of the *expected results*, including their projected contribution. These threads can be explained by their scales. At one extreme on the generalizability scale is a study that cannot be generalized beyond the single person in the local context in which she was investigated (e.g., a case study of an HIB event), and at the other extreme is a project that studies a behavior that is common to all humans. On the expected results scale, the possible emergence of a theme that may contribute to future research or to building a theory is on one end, and valid statistical correlations and evidence for causation that can be used for both building a theory and immediate application is on the other.

A typical research project in the first generation accepted limited generalizability and aimed at applicable results, while many projects in the second generation aimed at general results with a variety of contributions, often vaguely expressed. Related to these two threads, the transition from the first to the second generation brought to light new, more focused views of HIB: the cognitive and the in-context approaches.

6.1 The First Generation

Early researchers studied specific groups of users with the aim of generalizing for all members of the group, or over the same type of groups in any other location, and were not interested in other types of generalizations. In fact, numerous research projects were carried out to improve specific libraries and their services. These studies were motivated by the looming information explosion and the existing and potential capability of libraries and information centers to satisfy their users. Recognizing the significance of the issues, partly through their own experience, researchers had two main goals, which they sometimes addressed simultaneously: (1) to improve information services to certain groups of users, and (2) to advance the conceptual and methodological aspects of user-studies research. Intensive research was carried out by librarians as well as academicians in both the United States and England.

6.1.1 Studies of Scientists and Engineers

Early studies typically focused on identifying the type of documents and the information sources group members used, and how they used them. This limited scope is not surprising. Given that the studies' findings were supposed to improve libraries and information services, and given the nature of libraries before the digital age, the library component that could most easily be improved was the library collection.

Scientists and engineers were the first focus of research, which began in academic and special libraries, as well as in information centers. Regardless of the group studied, libraries and the services they provided were the center of interest, with very little attention paid to information sources outside libraries. In the United States, the most active research was conducted in research and development organizations within large corporations and government departments, primarily the Department of Defense (Paisley 1968). In England, early user-studies research focused on the use of academic libraries and was supported largely by government agencies, such as the British Library, the Advisory Council of Scientific Policy, and the Office of Scientific and Technical Information, each sponsoring large-scale studies. The first such study of social scientists—the INFROSS Project—began in England in 1968 (Brittain 1970; Line 1971), while in the United States, funds for research of scholars other than hard-core scientists were lacking (Line 1971). Crane (1971) reflected the attitude toward investing efforts in such scholars when she explained: "Information-seeking is probably more difficult in [social sciences] than in the basic sciences, but also perhaps *less imperative*" (6; emphasis added).

Studies of scientists and engineers focused largely on the information-seeking habits of users, investigating issues such as the type of material used most frequently (e.g., review articles, technical reports, colleagues) and the frequency at which actors used the library and information centers. In addition to recommending ways to improve a library's collection and services, some studies offered the scholarly community suggestions for future research. These proposals typically focused on specific aspects of information problems, such as needs and problems of a certain type of engineers or the use of patents.

Some scholars approached the information behavior of scientists and engineers from the viewpoint of the sociology of science. This approach made it possible to expand the research focus beyond the library and to include other aspects of human information interaction (HII) such as the creation, dissemination, and use of information (Crane 1971). While scholars investigated a limited range of topics, they enriched HIB research with a most important concept: "the invisible college" (Crane 1972), the informal network through which scientists exchange information with colleagues. This was the first instance of a large-scale, in-depth, and comprehensive study of humans as sources of information.[1] The concept of the invisible college and its attributes were developed by the psychologist William D. Garvey and his team at the Center for Research in Scientific Communication at Johns Hopkins University in the late 1960s (Garvey 1979). It was based on a series of systematic studies carried out by researchers from several disciplines and is possibly the most comprehensive series of explorative studies in HIB.

While scientists and engineers were first considered as one cohesive group, later studies showed that there was a need to study them separately. Engineers became a most popular target of study, and probably the most investigated user group. Not only are they still being investigated (e.g., Allard, Levine, and Tenopir 2009; Robinson 2010), but some groundbreaking HIB studies focused on this population (e.g., T. Allen 1977). First-generation HIB researchers ignored other professions by and large.

While most of the first-generation studies were focused on specific groups of users, after more than a decade of HIB research some scholars believed that there were enough data to draw some general observations. Among them were Faibisoff and Ely (1976), who carried their analysis of the HIB literature to the most desired type of research results at that time: They derived general recommendations for systems improvement. For example, analyzing the studies on scientists' information needs and uses, they concluded that, for an information system serving the group to be effective, a number of needs had to be met:

1. The need for more prompt dissemination of information ...
2. The need for quality filtering of information ...
3. The need for the right amount of information at the right time.
4. The need for receiving information in the desired form, usually oral or written, and in understandable language.
5. The need for active, selective switching of information ...
6. The need to browse ...
7. The need to get information easily and inexpensively ...
8. The need for awareness of current literature, and the need to know of work in progress.
9. The need to know about how to use available information systems.
10. The need for synthesis of the literature, state of the art reviews, and introductory surveys of subjects. (Faibisoff and Ely 1976, 6)

Most of these requirements seem commonsense today, a few may seem obsolete (e.g., "the need for more prompt dissemination of information"), and others might have been commonsense when they were "discovered" (e.g., "the need to get information easily"). Nevertheless, these early studies provided a solid base for future research not only with their findings, but also through their pioneering methodological and conceptual developments.

Although they had fewer resources, several studies investigated the information needs of people outside the work context, and others explored how actors, primarily students, used library catalogs.

6.1.2 Information Needs and Uses of the Public

The shift in the view of public libraries from "warehouses" to "information centers" motivated research of the public they served. With the goal of improving library services, most studies investigated issues such as the topics in which residents of a certain region, neighborhood, or community were most interested; the degree to which their information needs were met; and the level to which the residents used community information sources that were available to them (e.g., Rieger and Anderson 1968). A few studies limited their focus to particular groups in the general public—such as civic organizations and voluntary groups (e.g., Kidd 1976)—or to a particular type of information service—such as information and referral service in urban areas (e.g., Long 1976). Other studies carried out their claim for generalizability to the maximum,

investigating the information need of the "average citizen" (e.g., Chen and Hernon 1982; Dervin 1976).

The contribution of knowledge about the general information needs and uses of all residents of a country to the improvement of systems and services is limited because it can be achieved only on highly abstract levels. For example, one may hypothetically conclude that, in general, library services should increase their accessibility, but no generalizations can be made about how to improve it and at what rate. Even Faibisoff and Ely (1976), who attempted to arrive at generalizations and were successful for the scientific community, concluded in their analysis of general-public studies that the findings usually could not be generalized beyond the particular community that had been investigated.

6.1.3 Catalog Use Studies

The first study of catalog use was published in 1931, possibly the first study available to us in the field of HIB. Some additional studies followed, all for the purpose of improving library catalogs. The early 1980s saw a series of large-scale studies of the Online Public Access Catalogs (OPACs) carried out several years before the catalogs entered fully into use in large library systems. Catalog studies are still being conducted today, aiming at using advances in information technology to improve access to library documents.

Akers (1931) began a tradition in which researchers (most of whom were librarians) examined users' views of elements recorded on the catalog card. She surveyed undergraduate students about which elements they used, which were not useful, which ones the students did not understand, and which ones they would have liked to have seen. Other studies examined the elements that users had actually used when looking for information (e.g., Ayers et al. 1968; Kenney 1966; Tagliacozzo and Kochen 1970). While not limited to a professional group, such as engineers or chemists, these studies focused only on users of academic libraries.

The OPAC studies, on the other hand, investigated the use of catalogs in all types of libraries and offered researchers a variety of methods for data collection—methods that could not be employed when studying the use of card catalogs (Cochrane and Markey 1983). This set of studies was the first large-scale attempt to generalize the seeking of information across all users of one type of a system—the OPAC—and brought together researchers from both technical and human fields. These efforts to uncover general patterns were also carried out despite the fact that most scholars in previous research had concluded that useful large-scale generalizations could not be

attained. The findings of the studies were numerous, and it is difficult to form a cohesive picture of how they have contributed to our understanding of searching OPACs. In addition, technological developments have created a new generation of OPACs which has made only a small portion of the studies' results relevant to the current design of library catalogs.

In spite of the resources invested in catalog use studies, it is not clear what contributions they offered to advance cataloging or OPAC design, which were their main purposes. It is possible that studies in a particular library helped improve its catalog or services, but there is no evidence these studies contributed to cataloging standards—such as the Anglo-American Cataloging Rules (AACR)[2]—or to the design of online catalogs.

6.1.4 Expanding the Range of Generalizability

A few researchers aimed to establish generalizations that would cover all contexts. Flowers (1965), for instance, surveyed physicists and chemists in various settings throughout England to identify the information sources they used. He concluded that there were no differences among scientists in diverse settings, finding that they all preferred to rely on reviews and original papers rather than on patents and they preferred information from the scientific literature over that from colleagues. On the other hand, several researchers found that generalizations cannot be made. Summarizing the large-scale INFROSS project, Line (1971) claimed researchers found it impossible to establish "any consistent general patterns of social science users" (430), and that "No major patterns were detected which could be of use for information system design purposes" (430). Reviewing HIB research in general, Crawford (1978) similarly explained that "observations based upon limited populations and divergent methodologies have restricted our abilities to generalize and to develop theory" (63–64). Later, the first set of studies of searching behavior of online searchers (Fenichel 1980, 1981) led researchers to the conclusion that individual differences overcame any other variable,[3] and thus made it impossible to find common patterns of behavior.

Nevertheless, Faibisoff and Ely (1976) identified 14 general patterns in information behavior when they analyzed the research literature at that time. Some examples of the patterns they found are:

- People tend to seek out information which is most accessible;
- People tend to follow habitual patterns when seeking information;
- Face-to-face communication is a primary source of information;[4]
- Different types of persons use different sources of information;

- The quantity of information often exceeds the capability of the individual to use it;
- An inverse relationship frequently exists between the quantity of information and its quality;
- When information is needed, it must be timely, accessible and relevant. (9–11)

Based on the general patterns they discovered, Faibisoff and Ely (1976) recommended guidelines for the designer of information systems, including that the designer should identify the user in relation to his discipline or environment, and the system should assume that the user has not articulated his information need (12–15). While some of the general patterns and guidelines for designers are outdated or have proven not to be useful, others have stood the test of time and are still valid today.

6.1.5 The First Generation: Conclusions

The early period of HIB was a time of conceptual and methodological exploration with an emphasis on the application of study results to operating information systems. During this stimulating period, researchers faced for the first time issues that were central to HIB and its investigation. The diversity of methods and scales that they used supported the development of the relatively stable methodologies that have been employed in later studies.

Although most present-day research is different from that of the past, the pioneering work of first-generation researchers laid the basis for the emergence of the second generation. Several large-scale studies by first-generation researchers unearthed some basic details about information-seeking behavior (ISB) that could not be arrived at by common sense alone. For example, they exposed the complexity in the ISB process and in some of the dimensions involved, the important role that informal sources play in information acquisition, the existence of habitual patterns in ISB, and the high significance of accessibility. They also introduced some of the central concepts in HIB, such as *information need* and *gatekeepers*. In addition, several study reports and analyses of such reports contributed directly to the growth of the second-generation methods and frameworks by experimenting with multifaceted research methods and beginning the exploration for conceptual frameworks.

6.2 The Second Generation

Based on the experience and results of HIB research during the first generation, scholars in the second generation moved in a conceptual direction in which study results were expected to contribute to future research, rather than to the improvement of a

particular operating information system.[5] HIB research became a world of its own with an active internal life, free of the requirement of offering direct contributions to people and communities in the real world. Contributions to the HIB research world have taken the form of (a) actual suggestions for future research, (b) an increasing understanding of HIB phenomena, and (c) the creation of new conceptual constructs—ideally, models and theories—a contribution that has been greatly appreciated.

This focus on contributions to HIB research is typical of current research as well. The quest for conceptual developments is not new, however. As early as the 1960s, Paisley (1968) presented a conceptual framework for analyzing the HIB of scientists, and in the early 1970s, Lin and Garvey (1972) observed a growing realization among researchers of the need for a conceptual framework under which the various studies of scientists and engineers could be integrated. Yet the actual development of such frameworks began only after the transition into the second generation.

Since the transition, the number of user studies to improve a particular information system has been relatively small. Moreover, HIB studies that included some conceptual contributions have been perceived to be of higher value than those without such contributions. To arrive at the expected results, researchers in the second generation turned to one of the two extremes in generalizations:

1. Discovering properties of HIB in general, regardless of the actor's context and the system used. That is, focusing on the individual—rather than on a group of people, a profession, or a community—and carrying out research that leads to general results that are applicable to all human beings. With this focus, researchers have centered their efforts on studying the psychological aspects of the individual.
2. Investigating a group of people—which can be as small as one person—all in the same environment and acting under a particular situation, and arriving at findings that are applicable only to the members of the specific group. This brand of HIB research is called *in-context research* and has investigated individuals as representative of a group, but has also at times studied aspects of their social and environmental circumstances.

The search for general attributes relevant to HIB can take place in any type of study, including in-context research. Looking for general attributes that seem to be inherent to any person regardless of her environment and situation, a number of researchers turned to research in psychological factors, which has focused on the cognitive and affective aspects of information-seeking behavior (ISB).[6] In-context researchers have studied cognitive and affective aspects as well but not exclusively. They also have investigated facets other than work life, such as everyday life. Moreover, in-context

research has moved beyond seeking behavior and has investigated other phenomena in HII such as information sharing, using, and evaluating.

This chapter focuses on research leading to general results. The following chapter (chapter 7) discusses in-context research.

6.2.1 The Cognitive Viewpoint

A cognitive approach to the study of HIB is highly attractive. After all, interaction with information is a cognitive process. Indeed, a great part of HIB research is conducted from a cognitive viewpoint and most of its models, as discussed in section 3.3, are cognitive. Pettigrew, Fidel, and Bruce (2001) explained:

> At the heart of the cognitive viewpoint rests the concept of knowledge structures. This concept has been borrowed from the cognitive sciences. Knowledge structures are the sets of concept relationships that comprise each individual's model of the world. It is this model of the world that is seen to mediate an individual's information behavior. Each person will apply the knowledge structures that are required to perceive, interpret, modify, or transfer information.... In information behavior research, the cognitive viewpoint focuses fundamentally upon the individual, on understanding the way each person thinks and behaves in response to information needs. (47)

The psychological sciences have provided the conceptual basis for this HIB viewpoint by offering conceptual constructs such as theories, approaches, and concepts. Researchers in these sciences, however, have diverse understandings and interpretations of such constructs, a diversity that has often caused controversies among them. To display this variety, Bryce Allen (1991a) provided an example from knowledge studies, which, he explained, was most relevant to HIB work: "Knowledge is sometimes characterized as 'mental representations,' 'mental models,' or 'cognitive structures'" (6). This list clearly opens the door to various approaches and interpretations of psychological concepts in HIB research. Although this multiplicity of interpretations has not been contentious in HIB investigations, it has stood in the way of building a cumulative body of research.

Whereas the cognitive viewpoint was already recognized in early HIB research, the development of these models was based on the personal experience of the researcher, anecdotal evidence, and intuition rather than on systematic research.[7] In contrast, the second-generation cognitive viewpoint was based on mature research and systematic investigations.

Cognitive research has several flavors. Some of it is based on the assumption that stable, innate human cognitive attributes—i.e., cognitive style—have an effect on ISB, and aims at finding out how each of these attributes affects searching behavior. Other

parts explore cognitive attributes that have been acquired through learning and seek to find their effect on ISB. The majority of cognitive research, however, studies a variety of cognitive processes that are associated with ISB without considering individual styles or the effect of learning.

6.2.1.1 Cognitive Styles

Cognitive style is a term used in cognitive psychology to describe the way individuals perceive, process, and remember information, or their preferred approach to using such information to solve problems. While the term has various interpretations, it is perceived to be a constant, stable attribute of an individual's cognition. Cognitive style has various facets that were revealed through empirical studies—studies that not only uncovered these facets but also developed measurements and techniques to determine them. A measurement of a style may include several categories or present a continuum with emphasis on the extremes,[8] and one style may have more than one measurement. HIB researchers study how the cognitive style of an individual affects his ISB and, at times, the quality of search results.

Studies to investigate these effects are usually conducted as experiments. The researcher chooses the styles that seem most relevant, and applies the appropriate measurement to determine the cognitive style of each study participant. She then gives the participants searching tasks and measures elements in searching behavior; some studies also measure the quality of the results—usually applying the precision and recall measurements. Statistical analyses then select the significant correlations between cognitive style and ISB and/or performance. Some researchers looked at various combinations of two or more facets of cognitive style, and a few explored combinations with other variables such as gender, academic discipline, and searching experience.

The most commonly used measurement of cognitive style in HIB research has been the level of *field dependence*. Allen (1991a) explained that: "People who are field dependent tend to respond uncritically to environmental cues, while those who are independent will tend to orient themselves correctly in spite of environmental cues. Field dependence is associated with passivity, field independence with an active coping style" (21–22). Other measurements have been used as well, such as open-mindedness versus rigidity, holist versus serialist, and analytic versus undifferentiated. Other examples of cognitive style are visualizer versus verbalizer and impulsive versus reflective, but to my knowledge they have not been tested in HIB studies. Related to cognitive style are learning styles—such as the deep versus the surface approach and comprehension versus operation learning—and several researchers explored the effects of learning

style on ISB. In studies of cognitive style and learning style, searching behavior (the dependent variables) has been measured along various variables, such as the following:

- Time required to complete the task
- The number of nodes traversed to locate a relevant item (on the web)
- The breadth of the search (narrow or comprehensive)
- Whether the participants employed Boolean search, best-match search, or a combination
- Perception of the utility and friendliness of various attributes of the search system (such as being able to display search history and ease of navigation)
- How confident the participant was about the results
- The preferred color of presentation.

These studies generated various findings, each according to its research questions. For example, a study of web searching found that field-independent participants had greater clarity of thinking than the field-dependent ones (Ford et al. 2002), and field dependents spent a longer time in order to visit more nodes than field independents did (Palmquist and Kim 2000; Wang, Hawk, and Tenopir 2000). Palmquist and Kim (2000), however, found this difference only among novice searchers. Strategy shift was also investigated. Ford, Wood, and Walsh (1994), for instance, discovered that field-independent searchers changed their strategies during different experimental conditions much more than the field dependents did. Investigating the effect of learning style on search performance, Logan (1990) found that searchers with a particular learning style called *concrete experience* achieved lower precision and recall than those with other styles.

More directed were studies relating to user interface. Exploring the effects of cognitive styles with the aim of improving user interface is common in the area of human-computer interaction (HCI). Several HIB researchers have followed this tradition, examining how to tailor the interface of information systems to individual cognitive styles. Chen and Ford (1998), for instance, found that field-dependent individuals primarily used the menu, while field independents progressed sequentially using the backward and forward buttons. Chen, Magoulas, and Dimakopoulos (2005) studied the display of web directories and found that field independents preferred the subject categories to be arranged alphabetically, while field dependents preferred them to be arranged according to relevance. In addition, field independents preferred deep

category structure (i.e., few main categories but several levels underneath them), while field dependents preferred flat structure (i.e., many main categories).

One study that was conducted under semiexperimental conditions did not provide such crisp results. Vilar and Zumer (2008) asked participants to search their own requests and asked them to fill out several questionnaires before and after the search. Vilar and Zumer looked for correlations between individual characteristics (including cognitive style) and the perceived user-friendliness of the system. They could not identify simple overall patterns, but some single dimensions of individual characteristics could be linked to specific aspects of perception or preference.

This study and that of Palmquist and Kim (2000) provide the first indication that isolating cognitive style variables and testing their effect in the lab may not present results that are pertinent to real-life searching. In Palmquist and Kim's (2000) study, differences in cognitive style affected the web searching of novice searchers only. This finding can be interpreted to indicate that such differences may be overridden by experience. Vilar and Zumer's (2008) research demonstrated that once experimental conditions are loosened, it is difficult to discern the effects of cognitive styles. The main difference between this study and the ones with more typical conditions lies in the type of requests the participants searched. In experiments, all participants are typically asked to search the same set of made-up requests, while in this study the participants solved their own information problems. Vilar and Zumer (2008) introduced variability to the *context* of the search requests and thus were unable to observe the effects of the participants' cognitive styles. That is, context variables may also override those of cognitive style. Since every real-life search for information takes place in its own context, it is not clear whether a researcher who wishes his study results to be relevant to real-life conditions should focus on cognitive style.

Indeed, most cognitive style researchers did not see in their findings specific and direct implications for real life. They expressed their contribution as useful for the development of models of HIB, for showing the usefulness of an existing model, for the design of training for searching, or for providing hypotheses for future research.[9] One exception is the contribution to the user interface. Here the main premise has been that information systems should fit cognitive styles, and therefore the best user interface should have options for different styles. Some researchers did carry their studies further and developed prototypes of such interfaces.

Studies focusing on cognitive style constitute a definite part of research within the cognitive viewpoint. Less active but still within the realm of psychological sciences is research addressing personality traits and mental models. Both areas share their research approach with cognitive style studies.

6.2.1.2 Personality Traits

A relatively new area of research is the effect of personality traits on ISB. Citing Phares (1991), Jannica Heinström (2003) explained, "Personality is that pattern of characteristic thoughts, feelings, and behaviours that distinguishes one person from another and that persists over time and situation." This definition views cognitive style as a component of an individual's personality. Therefore, examining personality traits is, in a way, an expansion of the study of cognitive styles. Similar to cognitive styles, these traits are assumed to be innate to an individual and unchanging. The most comprehensive investigation was carried out by Heinström (2003), who set out to find whether "personality traits are likely to influence attitudes and behaviour ... in an information-seeking context." Personality researchers agree that there are five basic dimensions that can be used to describe differences in cognitive, affective and social behavior: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Heinström (2003) addressed all of them.

In a series of studies, each with a different population—all students—and at times with large samples, Heinström (2003, 2006) set out to find if there were correlations between the set of dimensions of personality traits and variables in information behavior, such as difficulties in relevance judgment, document selection criteria, experience of time pressure as a barrier to information, and effort used in information-seeking—all assessed by the participants themselves by describing their usual habits, mostly using a Likert-type scale. She found that information behavior can be connected to all five personality dimensions. Her results show, for example, that people with a low level of *neuroticism* have a positive attitude toward information-seeking and appreciate high recall; in addition, the more secure they are, the more actively they search for information (Heinström 2003).[10] A high level of neuroticism, on the contrary, implied difficulties in coping with unpredictability, disorder, and ambiguity in search systems (Hyldegård 2009). Another dimension, *competitiveness*, was related to experiencing lack of time as a barrier to information retrieval, problems with relevance judgment, and competence in critical analysis of information.

In another research project, Hyldegård (2009) could not confirm some of Heinström's findings. She carried out a naturalistic study of a group of people in an actual social situation, following students working in teams on a class assignment. Hyldegård observed them throughout the project with the purpose of finding out the effects of team members' personality traits on their information behavior within the team. She found, for example, that the participants had low levels of uncertainty during the project even though most of them had a high level of neuroticism. Attributing this seeming contradiction to the team situation, Hyldegård (2009) introduced the notion

that social settings affect the manifestations of personality traits. That is, one cannot generalize about the ISB of people with certain personality traits across all social settings.

6.2.1.3 *Mental Models*

Among the cognitive attributes that have been acquired through learning, mental models are most commonly employed in relation to information systems, their design, and the training to use them. Borgman (1984a) defined a *mental model* as "a model of the system the user builds in his or her head" (37). Mental models are crystallized through experience, some of which may include systematic training. Borgman explored the creation of mental models through training to determine the effect of two styles of training on retrieval performance. One type trained subjects by presenting a conceptual model of the system, and the other presented the procedures one can follow. She found that complex questions that required exploration were searched more successfully by those who received conceptual training, but there was no difference between the styles when subjects searched simple questions (Borgman 1984b).

Other studies of mental models took different directions. Zhang (2008), for example, studied the types of mental models undergraduate students had of the web and the relationships of these models with ISB. Earlier, Dimitroff (1992) found that the more complete the subject's mental model of the retrieval system, the more likely she was to make fewer errors and to retrieve more items. On a more general level, Marchionini (1989) reported that the mental models students had of print encyclopedias were useful for their searching of online encyclopedias. Other studies investigated some factors that contribute to the building of mental models and their effect on ISB, such as the level of domain knowledge—that is, the degree to which a searcher is familiar with the subject domain of the request (B. Allen 1991b; Jacobsen and Fusani 1992)—and searching experience (Ford and Chen 2002).

6.2.1.4 *Cognitive Processes*

Most researchers who are guided by the cognitive viewpoint have focused on the study of ISB as a cognitive process that is common to information seeking in all contexts and situations—regardless of personal attributes such as age or gender. These processes were first attended to in the early HIB models, such as Taylor's (1968) stages of a need's development and Krikelas's (1983) model of the search process. In fact, most of the action models in ISB describe cognitive processes (see section 3.3.1), and the second-generation concepts that were introduced, such as sense-making (Dervin 1992) and

anomalous stage of knowledge (ASK) (Belkin 1980), represent states in a cognitive process.

HIB researchers have investigated multiple aspects and processes. Some followed the information-seeking process from initiation to completion, and others focused on a particular state or activity. As the HIB models demonstrate, there is no one way to describe the seeking process. Each researcher outlines its stages according to her view, and no one description is generally better than the others.[11] While several models were based chiefly on the conceptual models and viewpoints of their creators, some have been based directly on systematic empirical research.[12] In a relatively early study, researchers analyzed the decisions that participants made during a search in an online catalog and concluded that their behavior resembled that of decision making in other contexts (Blackshaw and Fischhoff 1988). Another example is the pattern developed by Cole (1999), who identified five cognitive stages in the search process by collecting data from 45 students—beginning with "opening" and concluding with "effect of process."

Vakkari (1999), on the other hand, focused on one stage: He explored what triggers an individual to look for information. Based on studies of actors in workplaces, he concluded that the conditions that aroused this behavior were the nature of the problem to be resolved, the complexity of the task, and prior knowledge. On the other end of the spectrum, Berryman (2006) examined a much later stage in the search process and asked: How do people decide that they have enough information? Like Blackshaw and Fischhoff (1988), she concluded that the contextual factors she found to shape this decision are similar to those found by decision-making researchers.

The search process however, has not been the only focus of study. H. Bruce (1994), for instance, examined the dynamism of relevance judgment, and Spink and Park (2005) called attention to the multitasking that occurs in HIB, such as when an individual searches for information on two topics simultaneously, switching back and forth from one search to the other.

Identifying and measuring cognitive processes are challenging goals. Cognitive processes are not directly observable and do not present themselves in a quantitative form that can be directly transferred into measurements. Nevertheless, identifying and describing cognitive processes constitute a large share of HIB research, including in-context inquiries.

6.2.1.5 The Cognitive Viewpoint: Conclusions

The emergence of cognitive research signaled a step forward in HIB research. It is perceived to be more scholarly than previous research in several respects, including

its heavy reliance on conceptual constructs (usually borrowed from psychological sciences), its investigation of details rather than a broad-brush approach, and its capacity to offer general results. In particular, progress has been made because cognitive research has aimed at *understanding* HIB rather than merely *describing* it.

Cognitive research has indeed offered many contributions to the HIB field, particularly to its conceptual developments. It has shown, for instance, that (1) a search is an adaptive process with stages that can be clearly defined; (2) looking at a search as a problem-solving process opens the possibility of applying the rich results from decision-making research—both conceptual and applied ones; and (3) there are factors external to the individual that affect cognitive processes during a search. Cognitive research can also be applicable to training and education relating to information behavior. Even though the cognitive viewpoint is considered to be progress compared to the studies in the first generation, it is not "better" or more "progressive" than other types of HIB research. Similar to any other viewpoint in HIB research, the cognitive viewpoint has its own limitations.

In particular, this research has offered very few relevant recommendations for the design of information systems because the suggestions it presented are too general. For example, suggestions that there should be flexible online help, multiple access points, and an interface that matches the learning style of the individual user cannot guide the system designer because they do not specify the way in which online help should be flexible or when to provide a certain type of access points. McKechnie et al. (2008) substantiated this observation. In their analysis of the 117 research reports that were presented in the Information Seeking in Context (ISIC) conferences from 1996 to 2006, they found that 59% of the reports included implications for practice, but 56.5% of these reports used vague, general or otherwise unclear statements rather than explicit delineation of implications for practice.

This gap is not surprising for several reasons, especially because cognitive studies are descriptive (see chapter 9). Determining an individual's cognitive (and personal) attributes is a challenging task. To identify cognitive, personality, or learning styles requires users to fill in questionnaires, at times rather lengthy ones. How can a system identify these styles for each user, and once they are identified, what should the system do in order to operate in a manner that matches a user's style? One area of research that has attempted to resolve these issues is that of *user modeling*. Its goal is to design information systems that create a model of each individual user and respond to her input accordingly. While this is an active area of research that touches upon various fields such as human-computer interaction (HCI) and information retrieval (IR), it seems to have produced results that are limited to certain activities—such as clustering

web search results according to the user's area of interest—and various user's attributes—such as persistence in searching and long-term interest—none of which is a cognitive or personality trait.

Reservations about the benefit of cognitive studies to systems design were raised as early as the beginning of the 1980s when nonbibliographic information systems were first introduced. Huber (1983), for example, brought up questions about the value of cognitive style studies for the design of management information systems (MIS) and decision support systems (DSS). He concluded that cognitive-style research cannot "lead to operational guidelines for MIS and DSS designs" (567). Building on some of his arguments, I can offer the following explanations for his conclusion:

- Earlier literature concluded that other factors are better predictors of HIB. Huber quoted Chervany and Dickson (1978), who explained, "Researchers have not been able to predict consistently behavior/performance on the basis of individual personality characteristics. Rather, behavior appears to be (to a very large degree) determined by the characteristics of the task in which the individual is involved" (Huber, 1983, 569). In addition, since the characteristics of a task reveal themselves not in the lab but only in naturalistic settings, results of lab experiments cannot scale up to real-life situations.
- Research has shown that other personality traits may be relevant to systems design, such as response to uncertainty, responsiveness to organizational norms of rationality, risk-taking propensity, dogmatism, and previous training. Clearly, personality characteristics do not necessarily correlate positively among themselves. Suppose studies find that a field-dependent individual would benefit from a certain design requirement, while a person with previous training would require the opposite design. How would a system be designed to support a field-dependent user who has rich experience? The only way to arrive at a "reasonable solution" is to test HIB for all possible combinations of personality traits and then design systems that support each one of them. The number of such combinations is so large that this "solution" is practically impossible.
- Designing systems that match a certain cognitive style is not always useful. As research has indicated, some cognitive styles create barriers to information retrieval, and so it would not be beneficial to design systems that match such a style. On the other hand, systems that are designed to complement this style are likely to be avoided by individuals who possess it. In short, it is not clear how to fit system design to a particular cognitive style in order to improve interaction and retrieval.

Most important is the question of whether a certain style, independent of the context, induces consistent behavior. Two studies have already indicated that it might

not (e.g., Hyldegård 2009; Vilar and Zumer 2008). When studies were carried out without the controls commonly employed in a lab experiment, results were not clear-cut, which usually led researchers to conclude that some external conditions affect an individual's behavior more than his style. This repeated experience may lead to the conclusion that the findings of studies of style-induced behavior are valid for experimental conditions but may not be directly applicable to real-life settings. Researchers who are interested in contributions that can improve information systems may ask whether the cognitive viewpoint is relevant at this time or whether it is better to focus now on other attributes that clearly affect ISB and have the potential to guide design, such as the social environment and the nature of the task that motivated a search. Once systems can cater to these conditions, future research may add the cognitive viewpoint as icing on the cake.

Other limitations are the bounded realms the cognitive viewpoint has addressed and the justification for its generalizations. Almost all the conceptual contributions of this research were limited to the search process and have offered very little to the understanding of other realms in HII such as evaluating, organizing, or representing information.

In addition, generalizations are unwarranted for a considerable part of this body of research, and yet researchers have implicitly assumed that the effects of cognitive attributes are the same for nearly everyone and under any condition. The most obvious reason that the results cannot be generalized is the fact that the majority of the studies were carried out with students as participants. With the emerging evidence that searching behavior is also shaped by acquired cognitive attributes—such as mental models, subject knowledge, or experience—it becomes somewhat uncertain whether student behavior represents that of everyone else or even the same students when they, say, search the web for fun.

Furthermore, searching behavior is shaped by the functionality and interface of the search system. In fact, analyses in some studies heavily relied on the capabilities of the system employed in the experiment, so their results cannot be applied to the use of a different system. Findings from studies of searching traditional bibliographic databases, for instance, are not directly applicable to web searching. Some studies limited the experimental conditions to a degree that obviously defies any attempt at generalization. For example, how can a hypothetical study of LIS graduate students who search two factual questions on their school's web site be generalized beyond these conditions? Admittedly, most researchers in such cases mentioned in their research reports that their findings could not be generalized.[13] But the presentation of the findings usually states general facts without reminding the reader that all these

new discoveries are relevant only to the participants in the experiment. To make matters worse, even when it is clear that no generalization can be made, readers feel free to integrate them into their own work as findings that apply universally.[14]

In conclusion, although there is no evidence of contribution to design, and there have been some dead-ends in terms of applications, the cognitive viewpoint has been a major contributor to conceptual developments in HIB research.

6.3 The Chase after Variables

HIB researchers are still looking for variables to study. The desire to identify which variables affect HIB was one of the main goals of the early large-scale studies. Paisley (1968), for instance, issued a call to researchers: "we now urgently need theories of information-processing behavior that will generate propositions concerning channel selection; amount of seeking; effects on productivity of information quality, quantity, currency, and diversity; the role of motivational and personality factors, etc." (3).

One means scholars have applied to find useful variables is collecting data through questionnaires that address the variables they decided to study with the hope that associations among them would reveal those that affect HIB. Mote's (1962) study is a typical example of the use of a questionnaire to find variables that affect information behavior. Conducting a survey and analyzing records about requests for information at an information center in an R&D department, Mote found relationships between the occupation of the professional staff and (a) the type of literature they required, (b) the number of requests for information, and (c) the time it took to respond to a query.[15] Staff members who worked on projects that employed a single well-defined subject scored lowest on the three variables, whereas staff whose work required a variety of subjects with fuzzy borders among them scored highest.

In a summary of these large-scale studies, Vickery (1973) discussed a total of 41 variables. For example, studies found that the volume of searching a person conducted related to various variables, such as the size of his work team, his age, the nature of his job, and his scientific productivity. Also, the success of a search related to variables such as the nature of the person's institution and the nature of his job.

The purpose of these studies was to support the design of libraries. They were based on the implicit assumption that once a designer ascertained the characteristics of the potential users, she could consult the studies and decide how to organize and manage the library and what services to provide. Obviously, this approach was unrealistic for the same reasons that variables representing cognitive styles are not likely to guide

systems design: the number of possible variables and the interdependences among them is too large.[16] Moreover, because at that time enumerating the variables was based on the researchers' commonsense and creativity rather than on conceptual frameworks or on empirical research, there was always the possibility of missing variables that actually made a difference.

Second-generation researchers recognized the inefficiency in this trial-and-error method for uncovering influential variables and began to identify variables in a more systematic manner.[17] This task was made possible by the growing use of qualitative methods that were applied in naturalistic settings.

Accordingly, the central research question became "Which variables should we study?" rather than "What associations exist among a particular set of variables?" This new approach matches the common view that qualitative research should result in hypotheses that can then be quantitatively tested and generalized beyond the local context in which they were developed. Therefore, many studies asked the question: "What is the information behavior of X (a group of people defined by setting, life experience, profession, and various other aspects and their combinations)?" A large portion of these investigations employed an inductive approach—that is, building the answer from the bottom up without relying on a priori conceptual constructs.[18] The outcome of such studies was usually a list of factors that affect the participants' behavior—that is, a list of variables.

Another approach for generating relevant variables is to base their identification on previous research and conceptual constructs (e.g., Urquhart and Yeoman 2010). The studies in cognitive style, for instance, were all based on previous research in the cognitive sciences and on the measurements that were developed through some of these studies. Ingwersen and Järvelin (2005) also used previous empirical studies and models in HIB and IR as a basis for developing a model of information retrieval from which they derived variables. They went further and designed experiments to test the associations among these variables.

Despite some attempts to collect the variables that proved relevant to HIB, no core list of such variables exists—a fact that is still of concern to some HIB researchers. In fact, the multiplicity in approaches and methods that have been used to derive variables and test them makes it unfeasible to find a set of core variables that affect HIB. This situation is not surprising and is not likely to improve, given the complexity of HIB processes. Therefore, it might be the time for HIB scholars who favor general findings to limit the search for universal variables, and consider other types of useful generalizations (see section 7.3).

6.4 Lingering Issues

As early as 1967, Herner and Herner reviewed the literature about information needs and uses in science and technology and observed the following seven flaws in the research in that field:

1. The relatively few techniques used
2. The diversity of corpora of users to which these few techniques have been applied
3. The diversity and ambiguity of language in discussing the techniques that have been used and their results
4. The lack of innovation
5. The failure to build on past gains
6. The failure to profit from past mistakes
7. The frequent absence of rigorous experimental designs (Herner and Herner 1967, 2).

Their review, which was the second of its kind to be published, was based on 38 research reports, several of which were reports of large-scale studies. A year later, Paisley (1968), in a groundbreaking review article, added two additional requirements beyond the flaws noted by Herner and Herner: (1) the designers of information systems must recognize the need for user studies, and (2) theory must play a stronger role in research.

Does HIB research have the same failings 40 years later? Clearly, HIB research has matured and most of the issues raised by these authors disappeared or were shown to be irrelevant. Second-generation research employs a variety of techniques, and discussions about these usually follow a common standard and a relatively stable nomenclature, even when one concept has several interpretations, such as *the search process*. Theory plays an increasing role; researchers are frequently innovative, often on several levels; and the lack of rigorous experimental design is rare. In addition, the "diversity of corpora of users"[19] is not considered a flaw and is actually blooming with in-context research, which has provided valuable contributions. One flaw that still requires improvement is the rigor of research. In conducting surveys, for example, researchers accept low response rates even though such rates imply weak validity, and in naturalistic studies researchers ask participants to write a diary that details each information event, even though previous studies have revealed that participants find it difficult to integrate such activities into their work day. In addition, the gap between HIB and IR research still exists (see chapter 10).

The major lingering issue, however, is the lack of a cumulative body of research. Today, it is commonly considered advantageous among HIB researchers for each to create new ways of approaching research and to discover new concepts or phenomena. Although there are a few, relatively small, communities of scholars that share an approach or elements of it, numerous researchers have created their own individual lenses. Some have even created a research agenda that avoids a commitment to a certain view or to a stable type of actors and that tries on several lenses, one after the other. Further, even though most researchers are familiar with the literature related to their studies, it is not uncommon for investigators to fail to see the benefit they may gain from previous mistakes.

In summary, the list presented by Herner and Herner (1967) demonstrates that one of the main issues that plague HIB research today had already reared its head in the first HIB studies: Research is not cumulative. Contributing to this situation are (1) the failure to build on past gains and to profit from past mistakes, and (2) the diversity in approaches to research. The failure to learn from past research is a barrier not only on the path to cumulative research but also to conducting high-quality research. The diversity in approaches and methods, on the other hand, provides a richness that enhances the development of HIB research in spite of its drawbacks.[20] While it is unlikely (nor is it desirable) that one approach or technique would become the standard, one hopes that the coming together of the different approaches and techniques will result in the creation of fewer of them, but ones that are solid, useful, and central. Chapter 13 explains how the use of cognitive work analysis can support the conversion of diverse approaches.

6.5 Two Generations of Research—Conclusions: System-Centered versus User-Centered Research

The transition from the first to the second generation of HIB is often characterized as a shift from a system-centered to a user-centered view. On the surface it seems that the distinction between these views is clear and easy to determine: A study that focuses on a context-specific system is a system-centered one, while a user-centered investigation considers user attributes. Yet the distinction between the generations as reflected in these simple definitions is inaccurate and misleading. The term *user* by itself is system-centric because one looks at users of an information system. Without a system there are no users.[21] Moreover, it seems that studies conducted in the second generation are automatically considered user-centered unless they clearly focus on a context-specific system. For example, it is common to agree that studies in the first generation

were system-centered because they investigated people using libraries and bibliographic databases. At the same time, studies of web searching, which began in the second generation, are considered user-centered. Does the difference lie in the type of system? Clearly, this distinction is not supportable. In addition, the claim that second-generation studies have heightened the focus on the user is not valid. First-generation studies investigated many user variables (if different from those studied in the second generation), as well as environmental variables.

Most HIB researchers today claim to subscribe to the user-centered view, and yet a considerable number of studies are actually system-centered because they investigate users interacting with particular systems (e.g., a library catalog, a medical help system). Typical user-centered studies had already been carried out in the early 1960s. Mote (1962), for example, identified three types of scientists at Shell Research Ltd. and found the type of information services each one required—e.g., a self-service library for one type and intensive user support for another. Project INISS (Wilson and Streatfield 1977; Wilson, Streatfield, and Mullings 1979) observed a typology of workers in social services departments that led to recommendations for information services for each type. Admittedly, such studies were rare at that time. It seems, therefore, that the concept *user-centered*, particularly when it is used to distinguish between the two research generations, still lacks a stable interpretation among scholars.

Dervin and Nilan's (1986) *ARIST* article is considered the milestone marking the transition from the first to the second generation.[22] Based on a review of both empirical work and critical essays, they discerned an evolving position among scholars which recognized the need for a user-centered approach, that is, "to make information needs and uses a central focus of information systems, and ... the central focus" (7). Dervin and Nilan's unique contribution to the definition of the shift lies in their explicit and systematic distinction between the system-centered and the user-centered approaches, and their call for the development of the latter. They described the essence of the transfer when they delineated several basic conceptual and methodological aspects that typified the differences between the system-centered and the user-centered approaches. I have presented these in table 6.1.

This comparison offers a definition of each approach that better fits our circumstances than the common one. It indicates that the difference lies not in whether the study participants use a certain system or whether the goal of a study is to generate system-design requirements, but rather in the conceptual, theoretical, and methodological approach of the researcher. Under this definition, several contemporary research projects that are considered user-centered are actually system-centered.[23]

Table 6.1
A comparison between the system-centered and the user-centered approaches based on Dervin and Nilan (1986)

System-centered view	User-centered view
Information is objective; its meaning remains constant through the transfer from producer to receiver	The meaning of information is in the eye of the user
Users are passive recipients of information; they are informed when they receive documents	Users are purposive, self-controlling, and sense-making
User behavior can be predicted regardless of their situational context	User behavior is shaped by situational contexts
Studies focus only on the interaction between humans and systems	Studies are holistic, examining factors that do not relate directly to the interaction but that shape it, such as social and cognitive factors
Studies investigate external behavior	Studies investigate internal cognition
A consideration of individual attributes prevents prediction	Individuality can be studied systematically. People share common dimensions in constructing experience
Use of quantitative methods	Use of both quantitative and qualitative methods

Even though the work of Dervin and Nilan (1986) designated a generational transition, no precise date delineating one generation from the other can be specified because HIB development has not been linear. The difference between the generations and their shift in focus from systems to users is primarily epistemological (see chapter 8). Research projects today may have questions almost identical to those posed in the first HIB studies, and may even employ the same methodology. In addition, some second-generation "new" approaches had already been employed to varying degrees by first-generation researchers. The maturation process of HIB research has followed a spiral pattern with its threads gaining increased maturity, and with the first-generation research providing a solid basis for the second generation to thrive.

7 In-Context Research

As we have seen in chapter 6, first-generation research (considered system-centered) investigated contextual variables of users of certain systems, while second-generation research (considered user-centered) focused first on the person, regardless of the context. From these opposing views emerged a third view: in-context research that centered on a person in a context or situation. In-context research was formally established with the first Information Seeking Behavior in Context (ISIC) conference in 1996. This branch of research has grown significantly since then and has attracted the attention of researchers from fields other than library and information science (LIS), such as information retrieval (IR) and human-computer interaction (HCI) (Vakkari 2008).

It is commonly agreed among researchers that research investigating a particular context or situation cannot be generalized beyond the empirical setting. This "limitation" has caused various researchers in human information interaction (HII) to doubt in-context studies' ability to contribute to research and design. On the other hand, because it is confined to certain conditions, in-context research provides for in-depth analyses and the capacity to preserve some of the complexity that is typical of HII in real life—a depth and complexity that cannot be achieved in research aiming at generalizable results. Moreover, since there has been growing evidence that contextual elements shape HIB, it is more reasonable to consider context than to ignore it. Empirical in-context studies have ranged from case studies of one person in particular circumstances (e.g., Fidel et al. 2004; Kuhlthau 1997) to about 100 participants under a certain condition (e.g., George et al. 2006).

Today, even though a large portion of HIB scholarly work is in-context research, the community is still discussing the definition of *context*. Most empirical research, however, has overlooked this debate,[1] and the elements that are considered in the investigation in each research project draw de facto the boundaries of its context. One hypothetical study of the HIB of, say, inner-city high school students might include

the librarian, the teachers, and the budget restrictions as its context, while the context of another study might be composed of the librarian, the school's relationship with the community, the state's graduation requirements, and the racial mix of the city. Some of the contexts that have been selected have been highly specific, and some even unique. While the richness in the interpretation of *context* provides for discussion and reflection, this ad hoc understanding of context stands in the way of building a cumulative body of research that may lead to generalizations. Clearly, if each study of a phenomenon such as inner-city high school students examines a different context, the findings are incompatible and cannot be aggregated into a coherent accumulation of results.[2]

7.1 What Do We Mean by *Context*?

Generally speaking, the term *context* is construed in different ways, depending on ... the context. The *Oxford Dictionary of English* (2nd edition, revised) offers two meanings that are related to the concept *frame of reference*, which enhance our understanding:

- The circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood;
- The parts of something written or spoken that immediately precede and follow a word or passage and clarify its meaning.

This construal is not uncommon in LIS research, as Vakkari, Savolainen, and Dervin (1997) explained: "context constitutes necessary conditions for sufficient understanding of [the information needs and seeking] phenomena" (9). Another form of this interpretation is the idea that context creates meaning. Dervin (1997) argued that various epistemological views have created their own perception of the term. It is not surprising, therefore, that various scholars in HIB have their own understanding of what is meant by the term.[3]

Although not officially declared as such, in-context research began with the first user studies. First-generation researchers considered the context as the central force shaping HIB activities and conducted studies to find out its effects. While most did not use the term *context* and were not aware of the challenges to its definition, many of the independent variables they tested are likely to be considered today as part of context (see section 6.3). As early as the late 1960s, T. J. Allen (1969) reported on the contextual variables considered in previous studies that were found to affect HIB, such as the phase in the problem-solving process and the formal and informal structure of the organization. In addition, most first-generation researchers focused on well-defined

groups of users—such as scientists in basic research and scientists working in research groups—and on additional contextual elements, including the nature of the subject domain in which scientists work (e.g., self-contained versus drawing on other domains) and the social organization among scientists (Crane 1971).

Moreover, several first-generation researchers suggested the dimensions of a context that would be relevant to information-seeking behavior (ISB). The first to put forward such a proposal was Paisley (1968), who laid out the context of the scientist as a person within "almost concentric" systems. These were (1) the culture, (2) a political system, (3) a membership group, (4) a reference group (i.e., other scientists with similar characteristics), (5) an invisible college, (6) a formal organization, (7) a work team, (8) the scientist's own head, (9) a legal/economic system, and (10) a formal information system (Paisley 1968, 3–6). Other scholars put forward other configurations of context (e.g., Lin and Garvey 1972; Taylor 1991; Vickery 1973, 34).

Today, when an empirical researcher is unconcerned with the complexity inherent in the interpretation of *context*, she usually understands it, in a somewhat vague way, to be the background in which actors operate. In contrast, HIB scholars who have explored the meaning of *context* have been highly precise in explaining their own construal. HIB scholars have different opinions about whether context is composed of identifiable and stable elements or is fluid and dynamic and about whether it is the real context that is relevant to HIB research or the one that is perceived by the actor.

7.1.1 Fluid and Dynamic versus Identifiable and Stable Context

First-generation researchers conceived the context to be a composition of mostly discrete elements that were stable, such as the size of the actor's team, its management style, and the nature of the institutions in which the actor works. To guide the design of stable information systems, they conducted studies to discover these elements and their effects on searching behavior.[4] Most empirical research projects today implicitly assume a stable context, but conceptual discussions about context tend to highlight its dynamic and ever-changing nature. These views represent the extreme ends of a spectrum, and portray a rift between theory and practice. On one end, the assumption that elements in reality are stable and unchanging has no acceptable conceptual leg to stand on. On the other, it is still not clear how empirical studies address a fluid and ever-changing world or how they can guide practical applications.[5]

Most scholars do not reside at the extreme ends of this spectrum. It would be difficult to find a researcher who claims that some elements in reality never change. It is equally difficult, if not impossible, for information systems and services to be

dynamic and ever-changing to a degree that supports the fluid conditions under which HIB takes place. This system would have to update itself every time, say, a user updates her state of knowledge during a search process. The view of fluid context addresses the *situational* side of HIB, that is, it assumes that the actor's situation is in a constant state of change. At one moment a situation may be characterized by one set of conditions and in the next by another. Dervin's sense-making approach (see section 3.2.1), in which a person is viewed as going through life moving from one situation to another, is an example of this view.[6]

When one assumes that reality is dynamic but aims to conduct research that is applicable to practice, one can define *context*, as opposed to *situation*, to include regularities—that is, conditions that are relatively stable and evolve gradually—rather than those that change constantly.[7] Researchers can investigate patterns of processes and of the conditions involved with the recognition that specific applications to practice will be useful for a period of time, and new ones will have to be determined as practice evolves. In other words, when investigating HIB in context, a researcher takes a snapshot of the activities and the context, and analyzes the pertinent elements that are relatively stable to arrive at relevant applications. Once this analysis leads to the implementation of a new information system, a next round of improvements is planned. In this way, systems and services evolve with reality.

7.1.2 The Boundaries of a Context

The definition of *context* is not only a subject of discussion but also a practical matter. When conducting empirical in-context research, investigators define the context under study, that is, they define its boundaries by determining its composition. The boundaries have been defined through different methods: (a) ad hoc, (b) as a result of previous studies, or (c) with the guidance of conceptual constructs. A researcher who is the first to study the user group that is of interest to him often employs an ad hoc approach and is ready to discover its context.[8] In this case he approaches the investigation with the exploratory question: What elements external to the actors shape their HIB? As he applies qualitative, naturalistic methods with inductive analysis of the data, he develops findings that define the context for the target group. That is, "the setting" is being discovered by the research process and is not fully understood before data are analyzed.[9] Quite often, however, the researcher has access to previous studies that are relevant to his project. He can then use the contextual elements that have been discovered as a basis for his research or for other goals, such as testing, expanding, or refining the elements and thus redefining the context for the project's group.

Regardless of previous knowledge, a researcher may choose to be guided by conceptual constructs that lead to a definition of *context*. Fisher et al. (2004), for example, selected Granovetter's (1973) theory of the strength of weak ties, and the concept of *third place* (Oldenburg 1989) to develop the contextual concept of *information ground;* and Chatman (2000) grounded her concept of *small world* in several theories from sociology (see section 3.1.1). Similarly, Williamson's (2005) ecological theory of human information behavior was inspired by ecological theory, and the onion model of cognitive work analysis (Vicente 1999; also see chapters 11 and 13) has its roots in both systems thinking and ecological psychology.

One question that is relevant to determining the boundaries of a context has been neglected: What is the object of which we study the context? Most context-related discussions refer to HIB's context, but it is not clear whether the context is of the *person* who is carrying out HIB or of the *activities* involved. That is, is the context *structural* or *functional*? This difference has had a minimal presence in discussions about the definition of *context*. Researchers who wish to arrive at results that are applicable to practice, however, need to consider the choice between the two types.[10]

Paisley's (1968) construct of scientist-within-systems is a good example of a structural view of context. His systems within systems were carved out mostly from the organizational structure of the unit, and of more encompassing structures outside the organization, such as the political and legal systems. Another example is the conceptual model Baker (2004a) developed in the context of end-of-life care, in which a patient is enveloped first by the family group, which is then nested in the community. Both groups are then embedded in the cultural context and environment, which include several aspects, such as the physical, legal, economic, ethical/moral, and the health system.

To observe the differences between the structural and functional views of context, consider Baker's (2004a) model.[11] It is clear that family and community members affect the patient's HIB, and Baker's study has indeed shown that. But it is reasonable to assume that the *functions* that the family and community perform in relation to the patient are more likely to affect HIB than the family's *structure* or that of the community. Clearly, the structure of the family and the community contributes to shaping the functions they perform, and the functions in turn affect behavior. The nature of the relationship among family members, for example, may affect the patient's HIB. For instance, there might be a lack of communication and coordination that might make it difficult for the patient to get consistent information about the care of her children. What will shape her information behavior, however, is not the nature

of the family relationships but the lack of access to consistent information. That is, the function "Have consistent access to information about child care" is a requirement for the design of information systems and services to improve the situation that can be operationalized, rather than being a vague injunction, like "Consider family relationships."[12]

Moreover, some functions are likely to have the same effect whether they were performed by a family member or a community member. For instance, when a patient wants to watch a health channel on television, whether her cable bill is paid by her family or a community member is not likely to affect the way she will look for information and use it. The function that did affect her HIB was that of providing access to the television channel. Thus, while on a conceptual level it might be important to understand, say, the relationships between a patient and her family, what is relevant to the design of information services is the finding that a television channel is a desired source of information, and knowing the ways in which it can be made available.

This view of context—which advocates its applicability to real life—leads to the idea that context should be perceived as being a context of *activities* rather than of a person's context. With this view, personal attributes that may shape HIB—such as experience, knowledge of subject domain, and values—belong to the context because they shape HIB activities.[13] With the person-centered view, these attributes will be part of the person rather than of his context.

7.1.3 Real versus Perceived Context

What is more important for HIB—the actual context, or the context that is perceived by the actor? HIB researchers have two views, each providing the opposite answer. On one side are scholars who believe that actual conditions in real life, whether or not they are perceived by the actor, are those that shape HIB. We can call them the *realists*.[14] On the other side, the *constructivists*[15] believe that "reality"—whether or not it exists independent of a person's perceptions—is relevant only when and as the actor perceives it. That is, only the actor's constructed reality is appropriate for the concept of context, whether it was constructed through individual views, social interaction, or both. After all, an actor's actions are guided by what she thinks the conditions are.

While all first-generation researchers were realists, constructivist approaches have been taking their place among HIB researchers' views since the mid-1990s.[16]

The actor-constructed view of context is supported in part by the observation that, without it, HIB studies could not explain the variability among people within the

same context. This observed variability may be explained, the argument goes, by the diversity of user-constructed contexts. That is, there is no "objective" context with people in it; rather, each person creates his or her own context.[17] Thus, context and person are mutually dependent.

While there are various arguments to support a constructivist view of context, common to most is the observation that an actor-constructed context shapes an actor's behavior, which in turn shapes the context. An example may demonstrate this notion. Consider an actor who interacts with an information system. His perception of the system's functionality is an element in his context because the system is external to him and this perception shapes his HIB. Through interactions over time, however, the actor discovers new functionalities; that is, his perception of the system has changed and thus his context is changing. Namely, his HIB shaped his constructed context. In this way, context is fluid because it changes with any change of an actor's perceptions. As learning beings, humans constantly update their perceptions and, with them, their context.

A realist view, in contrast, is likely to perceive the context as relatively stable. A constructivist view focuses on the *person's* context, and a realist view may focus on the context of the *activities*.[18] Centering on the person has been attractive to scholars who see personal attributes as the main trigger to HIB activities and to those who are focusing on situational conditions. There is no doubt that personal attributes play a role, and that actors constantly traverse from one situation to another. It seems, however, that if these personal attributes were the major constraints to shape HIB, creating systems and services to support HIB would have been unattainable.

Like any other approach to research, these two views are guided by the researcher's worldview, and neither is "objectively" preferred to the other. Nevertheless, if the purpose of a research project is to contribute to the improvement of HIB in the real world, a realist approach is more promising. Because they focus on the activities during the search process, realists consider actors' perceptions of the context as *part* of the context, rather than its totality.

7.1.4 What Do We Mean by *Context*? Conclusions

The work of context scholars who harness their theoretical tradition to provide a meaning for *context* that guides empirical research is essential to the development of in-context research. Conceptual constructs and empirical research in HIB are not completely divorced from one another. At the same time, it is not common for empirical researchers to be explicitly guided by conceptual constructs.[19] Moreover, it is not

clear if or how conceptual discussions about context have supported empirical research that has provided applicable contributions to practice.

A view of context in HIB that can lead to practical applications construes context as composed of identifiable and relatively stable elements that exist in the real world. In addition, the context is a context of activities rather than of a person. Activities are shaped by the *level* and *type* of resources available to the actor, that is, by their constraints. Therefore, *constraints* are central to my understanding of *context*, and my construal of it is guided by my commitment to research that aims at offering relevant contributions to real-life conditions. In my view, context is created by the constraints that shape the HIB activities under study.

On the surface, this meaning of the concept assigns it to the category of "context as container" (Dervin 1997), that is, people (or activities) are contained within a context. This view is looked upon unfavorably by various context scholars (e.g., Dervin 1997; Dourish 2004; Talja, Keso, and Pietiläinen 1999) who focus on constructed context. However, my research experience and that of others—together with the dialectical materialism and the systems thinking approaches—have shown me that constraints may have prototypical, HIB-shaping elements that can be analyzed in empirical research, even if at times an actor does not perceive them. In fact, this pragmatic definition is relevant to the study of all aspects of HII: Context is created by the constraints that shape the HII phenomenon under study.

With this definition of *context*, one may ask: How is *context* different from *environment* since both are bounded by constraints? Indeed, researchers at times use the terms interchangeably. From a systems-thinking view, however, these concepts are different, and this difference highlights the unique nature of context. Environment is the set of a system's constraints and is essential to the definition of a system's boundaries.[20] *Context* is reserved for the constraints that actually shape HII activities taking place *in* a system. The time of day, for example, might be an element of the environment but not of the context if it does not shape the HII activities under study.[21]

With this interpretation, context is defined by the relationship it has with the studied phenomenon. While determining an environment is necessary in order to define a system's boundaries before a study commences,[22] the context of a phenomenon is left to be discovered as its investigation progresses.[23] That is, the discovery of the context of activities under certain circumstances evolves with the progression of an in-context study. In fact, for an in-context study to be relevant to practice, it should *investigate systematically* the context of HIB activities, rather than merely *describe* them, as is the common practice in current in-context research.

While most context scholars are likely to agree with this conclusion, in-context studies have often conclusively determined the HIB context before they began.

7.2 In-Context Studies

Most first-generation HIB studies investigated professionals in the workplace. The second generation brought a noticeable expansion in the range of actors studied. In addition to studying the HIB of nonprofessionals in the workplace, the field has experienced a growing interest in HIB in everyday life. This development has brought the advantage of opening up an almost endless range of user groups of actors and types of context in which researchers could apply their analytical instruments. But it has also raised new challenges with regard to defining the actors' context. The structure within which work takes place had served as a basis for context when studying HIB at the workplace, which usually is within an organization and operates according to policies and rules. Everyday life seems to be without a given structure and therefore provides no support for drawing a context's boundary. In addition, the large diversity of user groups and their conditions makes it difficult to discover some basic elements that are likely to be contextual for most everyday-life circumstances. Nevertheless, in-context studies have followed a similar methodological pattern regardless of the type of context.

7.2.1 The Role of Context in In-Context Studies

A minority of in-context research continues the tradition established by the first generation, collecting structured data from a relatively large sample of actors and analyzing them quantitatively (e.g., Eriksson-Backa 2008; Fikar and Keith 2004; Nicholas et al. 2009). In addition to exploratory investigations to determine a context's elements, many in-context studies set out to unearth the HIB of a group of users and are based on interviews—often semistructured—and, less frequently, on observation. Data are analyzed qualitatively, quantitatively, or both.

The study by George et al. (2006) is an example of a typical project studying the HIB of a group. The investigators studied the information-seeking behavior of graduate students from various disciplines at Carnegie Mellon University through in-depth, semistructured interviews with an untypically large sample of 100 students. The data were coded inductively as categories developed during the coding process. Because of the large sample, the researchers were able to provide both quantitative and qualitative results.

The quantitative results were descriptive statistics that compared responses among disciplines. The qualitative results described elements in the students' HIB: people who influenced their HIB (e.g., advisors, colleagues); their perceptions of the Internet as an information source; searching techniques (e.g., general, open-ended searches, citation chaining); the university library's online and print resources they used; and factors that affected their use of libraries (e.g., course requirements, need of convenience, speed). A summary of the findings showed that some of them were confirmed by results from previous studies, and a discussion provided suggestions for services academic libraries could provide to graduate students, such as providing more electronic resources, providing library instructions, and finding ways to increase awareness of the library and its resources.[24] The study report concluded with a strong statement about the need for more research.

This example demonstrates one of the major weaknesses of current in-context studies: Typically, researchers investigate the actors in a context, but not the context itself (see Courtright 2007;[25] Kari and Savolainen 2007).[26] Dervin (1997, 14) pointed to the lack of rigor with regard to context in empirical HIB research and explained that, most commonly, "Context has the potential to be virtually anything that *is not defined as the phenomenon of interest*" (emphasis added). Researchers perceive their studies to be in-context research because they study a relatively well-defined user group under certain conditions and conduct relatively in-depth investigations that cannot be generalized beyond the studied group. That is, the generalizability of the results is bound to a specific context. Such an approach generates descriptions of HIB but provides no means for understanding it.

In the study of graduate students, for example, an investigation of the constraints under which they look for information could have explained, say, their reasons for giving priority to people as information sources. These constraints may be created by the goals of the university and those of the students' departments, the standards of student-faculty relations and of the quality of students' work, or the level of access to technology.[27] Uncovering the constraints imposed on the students not only would have made it possible to understand their HIB, but would have created suggestions for improvements that were more likely to be effective. Let us assume that George et al. (2006) recommended that the library find ways to increase awareness of its services because the students in their study had not used the library to the level that could benefit them. It is possible, however, that students avoided the library not because they were unaware of its services but because it was not "cool" to use it. In this case, increasing awareness would not have been effective. Were the researchers

investigating the context, they would be likely to learn about the constraint and as a result recommend ways to make the library seem "cool."

In summary, studies that investigate HIB without understanding its context, or the relationships between it and HIB, are limited in their potential contributions. They may find nuances in HIB that have not been observed before, but they are unlikely to induce progress either in conceptual understanding or in practice.

7.2.2 Types of Contexts

How does a researcher select what user group to study? Availability of funding might be a criterion, particularly since naturalistic, in-depth studies are highly resource-intensive. Researchers whose work is independent of funding, or those who have easy access to funding, may select a study's context according to their research agenda. But other personal and circumstantial criteria also play a role. With this plurality of criteria, user groups that have been selected for HIB studies are diverse, with some colorful ones in the mix. Many studies have investigated ordinary actors, whether at work or in their everyday life. Examples include the use of mobile information systems by police (D. K. Allen et al. 2008), information seeking on health issues by women in a rural area (Wathen and Harris 2006), searching electronic journals to support academic tasks (Vakkari and Talja 2006), and urban young adults seeking everyday information (Agosto and Hughes-Hassell 2005).

A good number of studies, however, have focused on actors that are special in one way or another. Two trends in the choice of such groups are typical in HIB research. One is motivated by the concern for marginalized, vulnerable communities or those under adverse conditions. Studies about the HIB of immigrants (e.g., Courtright 2004; Fisher, Durrance, and Hinton 2004; Fisher, Marcoux, et al. 2004; Shoham and Strauss 2008), gays and lesbians (e.g., Fikar and Keith 2004; Yeh 2008), abused and neglected children (e.g., Hersberger, Murray, and Sokoloff 2006), the elderly in a language minority (e.g., Eriksson-Backa 2008), people at the end of life (e.g., Baker 2004a), battered women (e.g., Dunne 2002; Westbrook 2009), people in a state of increasing dependence and disability (e.g., Williamson and Asla 2009), homeless parents (e.g., Hersberger 2001), and social scientists studying stateless nations (e.g., Meho and Haas 2001) are a few examples.

Another trend is to investigate unique groups, those not in the mainstream of HIB research. Some such studies focus on people seeking paranormal information (e.g., Kari 1998); female police officers involved in undercover prostitution work (e.g., Baker 2004b); Canadian women pregnant with twins seeking information about baby feeding (McKenzie 2006); people involved in gourmet cooking as a hobby (e.g., Hartel 2006);

sperm-donor offspring looking for information about their donors (Cushing 2010); and a public library knitting group (Prigoda and McKenzie 2007).[28] While some of these examples are studies of highly specialized and unique groups, others represent trendy, middle-class activities. This trend is one of the indicators that a portion of in-context researchers greatly value the uniqueness and unusual position of the actors they select to study. Given the crucial role of information in everyday life and at work, it is not clear how studies of such inimitable groups contribute to the well-being of society.

7.2.3 In-Context Studies: Conclusions

Many in-context researchers would probably agree that the ultimate goal of their empirical research is to improve, whether directly or indirectly, systems or services for HIB, rather than to engage only in intellectual exercises. Yet the in-context research literature does not reflect this aspiration; indeed, conceptual investigations that lack practical implications have a strong presence in in-context research.

This statement is supported by a cursory examination I conducted of the 42 articles reporting empirical research that were published in *Information Research* as the proceedings of the 2006 and 2008 Information Seeking in Context (ISIC) conferences. Almost half of the articles (48%) offered no contribution, either to research or to practice.[29] Each concluded with a summary of the results, and some stated that the study brought a deeper understanding of the HIB of the actors in question. Almost a quarter of the articles (24%) reported on studies that were carried out to prove that a certain conceptual construct was a useful guide for research.[30] About 20% of the articles found either new variables or new relationships among known variables, and another 20% either provided one sentence about implications for design or gave very general and vague recommendations for planning and design (e.g., users need support for discovering).[31] Articles also reported on new models that were created through the empirical study (12%), claimed that the study pointed to an area that requires additional investigation (10%), and provided specific design recommendations (7%). Five percent of the articles claimed that their results could be generalized.

While not rigorous as a generalizable study, these numbers show the spirit of in-context research: Contribution to practice is low on the list of priorities. It is possible that some in-context researchers believe that since the results of their studies cannot be generalized, they can never be applicable to practice. Consequently, they may think it is better to focus on conceptual and methodological matters. This explanation does not account for the relatively large proportion of articles that lack any mention of contribution, however. The typical character of in-context research may explain why

many studies are unable to offer any contribution, and in particular, a contribution to practice.

In summary, the concept *in-context* is frequently understood as a tag for studies that focus on a particular user group. *Context* itself is commonly defined ad hoc as everything that is not the object of study (Dervin 1997, 14), and as such, it is rarely investigated.[32] Most often, when the context is explicitly addressed, it is described briefly, usually without consideration of whether the elements described relate in some way to seeking behavior.[33] In addition, the selection of groups to study is only occasionally guided by a comprehensive research agenda; more often it is driven by the interests of funding sources or solely by the personal interests and beliefs of the researcher.

Researchers are always guided by their personal interests and beliefs. Yet it is reasonable to claim that a problem-based field should also include a consideration of how the work contributes to addressing the problem at hand. This, unfortunately, is not evident in a considerable portion of in-context research.

7.3 Generalizations Derived from In-Context Studies

Can findings from an in-context study be generalized? It is accepted, as I stated at the beginning of this chapter, that findings of an in-context research project are valid only for the study's setting and participants. This limitation does not necessarily reduce the value of in-context research and its ability to present significant contributions: The new research strands in HIB that have emanated from in-context research, such as Chatman's (1987) concept of *avoiding information* and the introduction of the affective aspects of information-seeking by Kuhlthau and Nahl (2007) (see chapter 3), are examples of important contributions. Moreover, in-context studies—both individual ones and in aggregate—have the potential to arrive at certain forms of generalizations that are relevant to research beyond the specific groups and context of the study. There are at least three such forms:

- Expanding the population to which the study results are relevant
- Developing new methods and techniques for in-context research
- Finding *dimensions* or *categories* of elements that are relevant to all in-context studies.

7.3.1 Expanding the Population

Numerous researchers have tested the validity of their study's findings on additional actors, aiming at some level of generalization. Such a test is usually carried out through a survey that is based on a researcher's previous findings and is administered to a

sample of the population of interest.[34] This instrument facilitates statistical analyses, which in turn validate generalization. While this method is relatively simple to apply, it is also somewhat risky because the survey may not produce the desired results.[35]

A safer approach, albeit much more resource-demanding, is a gradual generalization through a series of coordinated qualitative studies. One way to accomplish this task is by using the method of controlled comparisons. A researcher studies a group of actors in a certain context and uncovers patterns in their information behavior. Next she selects for a second study a group that is similar to the first one but different in some identifiable attribute—such as a slight change in the context or in the activities. When the two studies are completed, she compares their results to identify commonalities and differences. The outcome is a description of the behavior of the actors in the two groups that is based on common patterns, with an identification of the differences. This process continues to include additional groups, one after the other—a process that expands the population whose information behavior is analyzed.

In a study about collaborative information retrieval (e.g., Bruce et al. 2003; Poltrock et al. 2003), the researchers followed this procedure and investigated three teams of engineers in the following order: (1) the software design team, (2) the hardware design team, and (3) the customer services team. An example may explain the process described above. In the observation of the software team, the researchers found that the software program manager, who was not involved directly in the details of the design but participated in some of the team meetings, sometimes presented the team with an information problem. No such event occurred at the meetings of the hardware design team, and the customer services team rarely had a team meeting. That is, on the surface, there were no apparent parallels to the types of information problems raised in team meetings among the other teams.

When investigating the manner in which information problems were collaboratively generated and identified, the researchers realized that for the software team some of the information problems were not generated by the team itself but rather were raised by the manager. That is, the problems were brought in from an external source. This discovery made the researchers recognize that the other teams also received information problems from external sources: the hardware team from the factory representative, and the customer services team from the customers.[36] Thus, the researchers concluded that all the actors they studied had to solve information problems brought by external sources, but each type of engineer received these problems from a different type of source.[37] In other words, one of the constraints under which the engineers operated was that information problems were delivered to them from external sources.

Following the process of controlled comparisons can expand the population for which the findings are valid, but it is not likely to generate general models for several reasons: (a) It would take a monumental, and probably impossible, amount of research to cover all possible populations in all possible contexts; (b) the more diversity is introduced, the more abstract the model becomes and the "final" model is likely to be abstract to a level that would render it useless; and most importantly, (c) since context has been shown to shape HIB, it is not useful to arrive at universal generalizations and thus eliminate its presence, particularly not through a series of in-context studies. Nevertheless, researchers can still expand the groups of actors and the context to a level they desire.

This inductive process is useful for the design of context-specific systems—those designed for a certain community of actors (see section 1.1.1.1). The engineers in the collaborative information-retrieval project worked in very large corporations, but the model can be expanded to include engineers in additional kinds of settings and of other types—such as safety or quality-control engineers. This expansion may lead to a set of requirements for the design of an information system for engineers with modules to fit a particular type of engineer and possibly a specific context. Such a process could also contribute to another aspect of generalization. Because it would require the employment of various methods and techniques, it could support developments in research methods. In addition, a study that aggregates the results of a series of studies is likely to arrive at dimensions or categories of elements that are relevant to in-context research in general.

In summary, composing a survey instrument based on the results of a single in-context study and administering it to a relatively large population—thus testing the validity of expanding the population—is the simplest method to arrive at generalizations. Yet this method is somewhat of a gamble since the survey results may indicate that the planned expansion is not valid. A safer way to arrive at a larger population is the controlled comparison method, which is much more complicated and labor intensive. Researchers who desire to expand a study's finding may use one of these methods or a combination of both.

7.3.2 Developments in Research Methods

Qualitative studies in general have the potential to contribute to the methods and techniques employed in in-context research. Because the object of study, rather than the method, is the center of qualitative inquiry, it is not uncommon for researchers to encounter situations for which they need to create new methods or techniques to arrive at their research goals. In-context research projects study HIB in a variety of

contexts, each of which may present its own challenges to carrying on the project. Researchers may need, for example, to devise a technique to tackle data that are difficult to access or to create a new way to analyze data when, say, the analysis that was derived from the selected conceptual approach could not offer substantial results. Qualitative studies in in-context research promise to contribute to the enrichment of the repertoire of methods and techniques that can be employed in in-context studies.

By and large, though, this promise has not been fulfilled. Although at times reported studies had required creative solutions to challenges in the application of their research designs, these innovations are usually buried in the research reports. Most often these new methods are considered a byproduct of the study—rather than being findings that are discussed independently—and therefore only researchers who read the study's report benefit from their novelty.[38] Moreover, it is not clear if all such improvements are reported. If placed in a methodological context, these methods would be of use to in-context researchers with diverse interests.

Suggestions for conceptual and methodological improvements are more common in the in-context research literature than the depiction of new methods and techniques. Typically, a researcher identifies a conceptual framework in another field—such as ecological psychology, decision theory, or the concept of the *third place*—and applies it to an in-context study. If the study is productive, the researcher concludes that the conceptual framework has been proven to be constructive to all in-context studies.

This conclusion is reasonable: If a methodological approach provided insights in one study, it is likely to provide similar outcomes across contexts. However, the introduction of such approaches requires systematic use and presentation in order for them to make a mark. Such systematic application has not been the case in in-context research, as the growth in new methodological and conceptual approaches has been unplanned and haphazard. This situation is clearly demonstrated by the fact that the number of in-context researchers who suggest such approaches is much larger than the number of those who consistently and repeatedly apply them. That is, most of the suggested approaches are short-lived, and neither their originators nor their colleagues have found them useful enough to apply them in additional studies. It is also possible that the drive to bring something new to the research landscape motivates some researchers to explore approaches that have not been applied before, whether or not the scholars are committed to them in their own research (see the discussion in section 6.4).

In summary, while the results of an in-context study cannot be generalized beyond the investigated conditions, this limitation is not a flaw. In fact, in-context studies

focus on unique and specific cases, which afford them in-depth investigations, and this focus is their strength. At the same time, it is possible to find robust methods and methodologies through these studies that will help advance in-context research in general. It is advantageous to the field to recognize this possibility and for researchers in the field to increase their participation in systematic methodological investigations and presentations.

7.3.3 General Dimensions

Even though specific findings of in-context studies cannot be generalized to other contexts, categories of these findings might be useful for in-context research in general. Consider the collaborative information-retrieval project previously discussed. Suppose the statement "Engineers receive information problems from outside sources" proved to hold for additional communities of their colleagues. Since it describes the way engineers work, the statement cannot be transferred automatically to other professionals or other types of communities. Moving the statement to a higher level of abstraction, however, creates the category "sources for information problems," which can be relevant to any context because information problems always have an originating source. Although it cannot be assumed that "sources for information problems" shapes the behavior of actors in other contexts, it is important to consider this category because it was found to be a constraint that shaped the information behavior of three communities of actors.

Identifying a category is just the beginning of a process. To verify its contribution to in-context research, scholars may check whether other studies found elements of this category to be behavior shaping, or they may examine its application in their future research.[39] If it is found to be relevant in a variety of studies, a category may be established and become a dimension in HIB research.

One may claim that *dimensions* are actually *variables* and that the latter have been investigated in in-context research from its inception. Indeed, on the surface, dimensions and variables seem to be one and the same. Yet they are different by their very nature. A variable is identified to test how different values that it receives affect other variables. The variable *age*, for instance, can be identified to study its effect on the variable *searching success*. On the other hand, a dimension is created to guide research by pointing to issues that are relevant to the study of a phenomenon. The concept *dimension* is also more abstract than that of *variable*. Consider the concept *social network*. As a variable, one may test the effect of different types of social networks on specific elements of seeking behavior: One can examine, for instance, how the size of a network is associated with the speed of utilizing it to receive information. As a

dimension, *social network* directs a researcher to investigate social networks in HIB studies and to uncover their attributes in the context of the studied phenomenon, rather than specifying which of its aspects or attributes should be examined. Most of the efforts to identify dimensions in in-context research have focused on looking for the dimensions of the system's context, while attempts at generalizations in seeking behavior itself have centered on the search for general variables.[40]

When examining dimensions in in-context research, it is common to distinguish between information behavior in the workplace and that in everyday life because the dimensions of the first are more visible than those of the latter. A workplace is usually part of an organization with its own policies and routines—and those are explicit and relatively easy to identify. Although routines and policies shape everyday behavior as well, it is more complex to determine them because many of them might be implicit.[41]

Nevertheless, Courtright (2007) reviewed in-context studies and gleaned several general dimensions that are relevant to both workplace and everyday life: social dimensions (e.g., social networks, social norms, and workplace requirements for collaboration); rules; resources; culture; and task (in a workplace) or problem situation (in everyday life). She found that each dimension was investigated in a number of studies, which is an indication that some conversion is beginning to occur.

When investigating a dimension, a researcher has to decide which of its aspects or attributes to study. To return to the previous example, how should one study a *social network*? Should one examine the strength of ties (e.g., Pettigrew 1999), the stability of the network, its acceptability, or its size? There is no one answer, nor is it desirable to define general aspects. These aspects are particular to the goal of a study, to its methodological approach, and to the studied phenomenon. That is, while a dimension may be established as almost universal, the aspects to be investigated are determined by the researcher according to the particular study.

The dimension *task* provides an example of how the relations between a dimension and its aspects play out.[42] Task is a common dimension for analysis in in-context research (Byström 2007),[43] and is usually viewed as a container of variables.[44] Researchers have defined these variables to examine the effect of the task variables on searching variables. The most commonly used variable is *task complexity*, which has been studied and analyzed by various researchers (e.g., Byström and Hansen 2002; Vakkari 1999). The purpose of task-complexity studies has been to investigate how the level of complexity affects searching behavior.[45] Other variables have been recognized as well, such as task support and prior knowledge relating to the task (Solomon 2002) and task stages and their timeframe (Xie 2009), but they have not been investigated (to my knowledge). Identifying these particular variables was unsystematic, based on either

research in other fields or a single research project in HIB, or defined with the help of a researcher's intuition.

Borlund (2000, 2003a, 2003b, 2009; Borlund and Ingwersen 1997), on the other hand, viewed a task in its entirety, and recognized that it shaped information-retrieval behavior. Her goal was not to analyze tasks but rather to find ways to introduce them to experiments into information retrieval and evaluation. One of her suggestions was that participants in an experiment be given a description of a task as a context for the made-up requests they are asked to search, and that these tasks be typical to those carried out by the participants in their own lives. This way, participants who are university students, for example, would be given queries that are relevant to student life.

In between these two approaches is the framework of cognitive work analysis that perceives *task* as a dimension, rather than as a container of variables or a solid entity that remains unanalyzed. It names the aspects of a task that should be examined when one wishes to understand an investigated task in a way that is relevant to information interactions. These aspects were derived systematically from theoretical constructs and empirical research, and are based on an abstraction hierarchy (see section 12.1). Viewing the task as an activity, the framework suggests that when studying information interaction in context, one investigates the task's goals, priorities, general functions, the processes and resources required to accomplish the task's goals, and the decisions that need to be made. In an in-context study that is guided by this framework, researchers analyze each task according to these aspects.[46]

This example demonstrates the value of dimensions to in-context research. It may serve as a container for variables, but more importantly, it is a guide for research design. While a dimension is deemed relevant to all contexts, it can still be tailored to the requirements of individual studies, as the unique conditions of each study determine the specific aspects to be selected and analyzed.

7.3.4 Generalizations Derived from In-Context Studies: Conclusions

In-context research focuses on studying unique and special cases of particular user groups, each in a certain context. Should its ability to offer findings that are relevant beyond the case under study be of concern? Some may claim that this is an important issue because only results that can be generalized are of value, and therefore outcomes of in-context studies are of no significance until they have been generalized. Yet not many in-context researchers are likely to subscribe to this view. They realize that context shapes information behavior and that to *understand* this behavior requires a consideration of the context. For this reason, they are interested in particular conditions. This focus does not mean that an in-context researcher should not consider

contributions that are relevant beyond the specific conditions in his study. For a field to develop, it is necessary for investigations to contribute to the field itself, not only to the understanding of the particular studied phenomena. That is, having studies with broader implications is beneficial to the well-being of the field. In addition to generalizing in-context study results by surveying additional populations, researchers can best contribute to the field through discussions about new methods and techniques they employed and by uncovering general dimensions that are relevant to in-context research in general.

7.4 In-Context Research: Conclusions

In-context research is growing on both the empirical and the conceptual levels as well as with respect to methodological investigations. In the conceptual arena, several scholars have suggested that a context's boundaries are fluid and its elements are constantly changing. Such a construal of the concept, however, makes it almost impossible to conduct empirical studies that lead to implications for practice because some stable core elements are required for the design of information systems and services. Indeed, most empirical in-context research has assumed, if implicitly at times, that the context they investigated was stable and well defined. However, while contributing to the description of the HIB behavior of certain user groups, most in-context empirical studies failed to provide guidance for the design and management of information systems and services.

To improve the applicability of their studies to practice requires in-context researchers to do the following:

- Focus on activities rather than on the person. While the personal attributes of an actor and her psychological state shape her HIB to a certain degree, her information problems are motivated by activities in which she is involved—rather than merely by personal and situational factors—and thus strongly shape HIB. When a person is leisurely looking for a good movie to rent, she is likely to exhibit information behavior that is dissimilar to her behavior when she is looking for legal information on the job. It is useful, therefore, to study the context of an actor's activities, rather than that of the actor as a person.
- Investigate the context. Most in-context researchers consider a study of a certain group of people as an in-context study. At times they only name the group—e.g., graduate students, nurses, immigrants—and at other times they describe the context, most often fairly briefly. While usually interesting, most of these descriptions do not point to the relations between the context they describe and the information behavior

of their actors. Therefore, they are not likely to contribute to the *understanding* of the group's behavior—which is the goal of in-context studies. In addition to providing understanding, an investigation of the context may lead to the construction of a formative model because it describes the constraints under which the actor operates (see section 10.1.1)—the type of model that is essential as a guide to the design of systems and services.

In-context empirical researchers have not followed this direction in their research. As a result, very few studies have provided insights that are relevant to the design and management of information systems and services. Chapters 11 and 12 introduce an approach that guides investigations of actor activities and their context: the cognitive work analysis conceptual framework.

At the same time, conceptual in-context research is alive and active, if in limited quarters. In addition to conceptual discussions, empirical studies have brought to light new concepts, variables, and research methods—despite the unique and special nature of each study. Indeed, a growing number of researchers recognize the importance of the conceptual and methodological contribution that individual studies can offer, instead of lamenting their lack of generalizability. However, the task of bringing convergence to these diverse and disconnected contributions still lies ahead for the in-context research community.

8 Theoretical Traditions in Human Information Behavior

Theoretical traditions play an important role in empirical research, whether or not a researcher recognizes them, and human information behavior is no exception. Each method used in an empirical study has roots in methodological and theoretical traditions. The method *micromoment timeline interview* (Dervin 1992), for example, is derived from the sense-making methodology (see section 3.2.1), which is grounded in a number of theoretical traditions. Research in every field, discipline, and science is directed by such foundations, which together embody its theoretical traditions.[1]

Research in human information behavior (HIB) has been guided by a range of theoretical traditions in the social sciences and the humanities and has explicitly addressed some of them, mostly in theoretical writings with a few applications to empirical research. This chapter examines on a general level how theoretical traditions have been viewed and used in HIB research; it does not provide a survey of these theoretical traditions or describe individual ones. Since the discussion requires a mention of some elementary philosophical concepts, the chapter begins with a simplified presentation of some basic issues.

8.1 Some Basic Issues

A theoretical tradition—such as positivism, phenomenology, or constructivism—is based on certain *epistemological* and *ontological* foundations. An epistemological stance has distinctive answers to questions such as: What is knowledge? How is knowledge acquired? How do we know what we know? Why do we know what we know? Benton and Craib (2001) explained that an epistemological stance implies a set of "criteria by which to distinguish genuine knowledge from mere belief, prejudice or faith" (181).

An ontological stance reflects a position about "what kinds of things or substances there are in the world" (Benton and Craib 2001, 183). Each stance offers its own

answers to questions such as: What is existence? What is a physical object? What does it mean to say that an object exists?

For the analysis of philosophical issues in HIB, the discussion here distinguishes between the empiricist epistemological stance and the set of all the other stances that are not empiricist, and between the realist ontological stance and the nonrealist one. For an individual researcher, both epistemological and ontological stances are born from her worldview and her understanding of the place of research in the world.[2] Thus, while a phenomenon can be studied from both realist and nonrealist stances or from empiricist and nonempiricist stances, and while a theoretical tradition may be based on more than one specific epistemological or ontological stance,[3] researchers preserve their stance across their work unless their worldview has changed.[4] This consistency does not imply that researchers always adhere to one theoretical tradition; in fact, it is not uncommon among HIB researchers who apply theoretical traditions to harness more than one, even in one study. These researchers, however, usually select epistemologies or ontologies that are compatible.

8.1.1 The Empiricist Stance

The empiricist stance was originally developed for the natural sciences, in which it is still the dominant approach.[5] Benton and Craib (2001) explained:

> [T]he empiricist view of science can be characterized in terms of seven basic doctrines:
>
> 1. The individual human mind starts out as a "blank sheet." We acquire our knowledge from our sensory experience of the world and our interaction with it.
> 2. Any genuine knowledge claim is testable by experience (observation or experiment).
> 3. This rules out knowledge claims about beings or entities which cannot be observed.
> 4. Scientific laws are statements about general, recurring patterns of experience.
> 5. To explain a phenomenon scientifically is to show that it is an instance of a scientific law....
> 6. If explaining a phenomenon is a matter of showing that it is an example or "instance" of a general law, then knowing the law should enable us to predict future occurrences of phenomena of that type. The logic of prediction and explanation is the same....
> 7. Scientific objectivity rests on a clear separation of (testable) factual statements from (subjective) value judgments. (14)[6]

Most central to the discussion in this chapter are doctrines 2, 3, and 7. That is, researchers in this tradition claim that a statement constitutes knowledge, rather than a belief, only if it can be tested empirically and proven or disproven. Because testing requires observable entities, knowledge can be arrived at only from entities that can be observed. In addition, when created through testing, scientific knowledge

is objective and free of value judgments. The most well-known empiricist approach in the social science is *positivism*, which claims that "Scientific method, as presented by the empiricists, can and should be extended to the study of human mental and social life, to establish these disciplines as social *sciences*" (Benton and Craib 2001, 23).[7]

The stances of nonempiricists are diverse and nuanced. Rationalism, for instance, maintains that knowledge can be established through the use of human reason, and relativism argues that there are no context-free criteria that can guide a judgment between different points of view. While the differences among these epistemological stances are significant, this chapter ignores them for the sake of clarity. With these complex issues, simplifying is likely to lead to misrepresentations. The purpose of the chapter is to examine the patterns in which HIB researchers attend to theoretical traditions, and yet a reliable explanation of them all would require a book of its own. Some of these nonempiricist theoretical traditions have been elucidated in the HIB literature (e.g., Benoit 2007; Budd 2005; Hjørland 2004, 2005a; B. Jones 2008; Leckie, Given, and Buschman 2010); Radford and Radford 2005; Sundin and Johannisson 2005; Talja, Tuominen, and Savolainen 2005; Vickery 1997; Wang 1999; Wikgren 2005; T. D. Wilson 2003).

8.1.2 The Realist Stance

Realists hold the position that reality has an existence independent of how people know it and how they perceive it. More precisely, a realist has the "view that (some of) the things about which we have beliefs are independent of those beliefs and are, in principle, knowable" (Benton and Craib 2001, 184).[8] This view is easy to accept in the natural sciences, as is concisely reflected in Gertrude Stein's sentence, "A rose is a rose is a rose." The objects of study in the social sciences, however, are humans and groups of humans, which have certain abilities to intervene in the world. Therefore, a realist HIB researcher studies not only reality, independent of participants' knowledge and perception, but also the participants' perception of reality (see the discussion in section 7.1.3). Two researchers who study the human perception of a phenomenon can hold opposite ontological stances: One maintains that these perceptions are reality in its totality (the nonrealist), and the other (the realist) claims that they are views of reality—as well as being part of it—and that reality itself is independent of the participants' perceptions of it.[9]

Most popular among the nonempiricist and nonrealist researchers in HIB are the interpretive stances, such as phenomenology, constructivism, and hermeneutics—that is, those that concentrate on the interpretation of human actions and cultural

products and claim that all knowledge is a matter of interpretation. Positivism, on the other hand, requires realism. If there is no objective reality that is independent of humans', how can a researcher be objective? In fact, at times *realism* and *positivism* are mistakenly used interchangeably.[10]

8.2 Patterns in Reliance on Theoretical Traditions

The most prominent shift in HIB research has been the gradual move from a focus on fixed attributes—such as *the experience of an actor* or *the physical environment*—to the inclusion of dynamic and process-related phenomena as objects of study. This shift was accompanied by a growing acceptance of interpretive approaches in a predominantly positivist research field. Yet HIB is taking its very first steps in the philosophical and methodological world and is very far from reaching the initial stages of maturity. Among the many challenges the field faces are the HIB researchers' disinclination to consider methodological issues and the inconsistency with which these issues are addressed when they are considered.

8.2.1 Researchers' Attention to Methodological Issues

HIB researchers in the first generation applied the "scientific method," that is, positivism. This preference is not surprising because most often researchers in the United States were scientists or engineers in their organizations and so they applied the methodological approach common to the natural sciences. Social science itself had just begun to accept other theoretical traditions into its empirical research at that time, and it was too early for these to migrate into HIB work.

A clear example of the adherence to positivism was provided by Bawden (2008), when he summarized Bertram Brookes's philosophical writings about the science of information:

> [S]uch a science would be based on several foundational principles:
>
> • its main role would be "the exploration and organization of Popper's World III of objective knowledge";
>
> • it would be scientific, in that all the data studied would be "publicly observable and the whole approach objective";
>
> • it would require a recognition that information and knowledge were not physical, but "extra-physical entities which exist only in cognitive (mental or information) spaces";
>
> • quantitative analysis would be paramount, using techniques from the physical sciences, adapted to cognitive spaces. (418)

Bawden also noted that "Brookes' series of papers has been highly influential and widely cited, and continues to be cited to the present day" (418).

Positivism is still strong today, and relatively few HIB researchers consider alternative theoretical traditions. The majority follows the "scientific method," or ignores the issue altogether and continues "the way we have been doing research," following the methods demonstrated by their mentors and other researchers. As a result, a significant portion of HIB research is positivist.[11] At the same time, though, positivism has become much less appreciated by social scientists, and therefore very few researchers see themselves as positivists.[12]

Positivism in HIB research is manifested not only by the disinterest in theoretical traditions (Hjørland 2004) but also by the explicit adherence of some researchers to the empiricist doctrines listed above from Benton and Craib (2001). Positivist arguments can be found in various articles. Järvelin and Ingwersen (2004), for instance, argued, "Theoretical understanding must be grounded on observables. Otherwise it turns into speculation." Ford (2004) stated, "An essential defining criterion of *research* is that it should produce evidence that is open to, and bears, scrutiny. Implicit in the concepts evidence and scrutiny is the notion of objectivity" (1169).[13] Similarly, Järvelin and Wilson (2003) required models to have explanatory power, that is, "the ability to explain and predict phenomena" (see Benton and Craib's doctrines 6 and 7 above). A testimony to the deep diffusion of a positivist theoretical tradition can be found in data analyses and in the presentation of results. Statements about a study's limitations are an example. Although every study has limitations, most quantitative-study reports do not include a "limitations" section, while most of the qualitative ones do spell out their limitations. Determining what is a "limitation" seems to follow informal, yet well-established standards. For instance, most, if not all, qualitative-study reports have followed these standards and caution that their findings cannot be generalized. Yet these standards are not all-encompassing and they ignore other issues that can be considered limitations. For instance, "providing no contribution to theory development" is a limitation, but researchers do not point to it (to my knowledge). The widely held focus on generalization has been induced by the prevailing positivist approach that requires generalizability but releases studies from other duties such as generating new theories.

On a more general level, it seems that most HIB researchers strive toward objective results. Statements of facts in a research's findings are rarely qualified with the researcher's point of view or her theoretical approach. This "objectivity" is attained through experiments and through quantitative analyses of well-defined, observable

variables. In addition, most HIB studies limit their investigations to the observable and avoid the development of findings through rational means.[14]

A simple example may elucidate this point. In a study of sanitary workers for the City of Seattle who used mobile computers (Fidel et al. 2007), my colleagues and I thought that interacting with the system was somewhat complicated and far from intuitive. Nevertheless, all workers could interact with the system with a reasonable level of proficiency. One of our findings at that point was that the workers had received some type of training, even though we had not observed the training directly nor heard about it through interviews.[15] This type of finding would probably not be considered a genuine knowledge claim by many HIB researchers because it was not based on observables.

Centering on the observable sometimes leads to false knowledge claims, according to positivist criteria. One example is the use of questionnaires to establish facts. Researchers ask respondents to answer questions that are objective in the researchers' eye,[16] and then present the results as facts about reality, rather than as the participants' *perception* of reality. As a hypothetical example, a questionnaire might ask study participants about their searching behavior, with questions about objective issues such as the level of their experience, the frequency of their web searches, and the number of searches they conduct simultaneously. Researchers would then compile the results and present them as facts, that is, as genuine knowledge claims. On a closer examination, however, it is clear that at least two of the questions are not objective according to positivist criteria—those about the level of experience and the number of simultaneous searches. Answers to the former present the participants' perception of the level of their experience, which may be viewed differently by others. Answers to the question of simultaneous searches clearly depend on the participant's understanding of the concept *search*, which may be different from that of the researchers. According to positivist criteria, the objective level of experience needs to be determined through observables. In the experience case, this determination can be accomplished by means such as a test administered to all participants to determine their individual levels of experience.

Despite the dominance of positivism, which is partly generated by a lack of knowledge and recognition of theoretical traditions, interest in theoretical traditions is rising among HIB researchers (Cronin and Meho 2009). HIB research literature shows that a few researchers have selected a set of theoretical traditions as their guide, the majority of which are interpretive.[17] Most active in analyzing these traditions are researchers in the European Nordic countries.[18] Among them, some have limited their research to the theoretical and philosophical levels, while others have been engaged in empiri-

cal research as well. Their work has been influential to some extent, and their approaches have not only been accepted but have been followed by other researchers, particularly in the area of in-context research.

In summary, while most HIB researchers have, with or without intent, followed the positivist theoretical tradition, new voices have championed interpretive approaches. At the same time, the number of discussions and debates about methodologies and about theoretical developments has been on the decline (Kim and Jeong 2006; Vakkari 2008). It is hoped that the attention to new theoretical traditions will encourage other researchers to increase their knowledge about them and their engagement with them.

8.2.2 Misconceptions and Contradictions

Two trends are typical among the researchers who are cognizant of the contribution of theoretical traditions to HIB research. Some researchers write about certain theoretical traditions and may also be engaged in empirical research that is guided by them, while others are avid empirical researchers who thread methodological assertions into their research reports or their reflections on their empirical work. While the former are usually highly familiar with the theoretical traditions they discuss and their historical and philosophical roots, the latter are usually less proficient. This relative lack of knowledge may lead them to include some misconceptions or contradictions in their view of the theoretical traditions they select to employ or discuss.

For example, although positivism is dominant in HIB research, researchers may have misconceptions about its doctrines. T. D. Wilson (2003), for instance, explained the reasons for rejecting positivism when he discussed the need for a theoretical tradition unique to HIB.[19] After examining papers that were prepared for a conference, he concluded that their shortcomings were rooted in positivism, which emphasizes quantitative analyses and provides very little understanding of information behavior, context, or the factors that affect information behavior. These shortcomings, however, are not those of positivism but probably of the papers he examined. While a positivist study requires quantitative analysis and an interpretive study requires a qualitative component, quantitative and qualitative analyses can both be employed with the positivist theoretical tradition and in other theoretical traditions as well. The difference is in the role the results play in knowledge claims. A positivist study, for example, may conduct a qualitative investigation to generate hypotheses, rather than knowledge claims. Similarly, a nonpositivist one may carry out a quantitative analysis to guide the development of the study's sample, rather than generate knowledge claims. The other shortcoming Wilson pointed to—that of providing little understanding of behavior and its context—is not a flaw of positivism, but rather

of the research project being examined regardless of the theoretical tradition that guided it.[20]

Another type of misconception is the unwarranted claim about the employment of a theoretical tradition. The simplest way to make this claim is by stating its use, ignoring other methodological considerations distinctive to the theoretical tradition. A typical example is a hypothetical researcher who declares that her study is guided by the systems approach because she is designing it with a holistic view, but then ignores the fundamental requirements of the approach, such as giving a boundary definition for the studied system and examining the interactions among its elements (see section 1.2). While her approach is holistic, her study is not guided by the systems approach.

Contradictions may also surface when a researcher applies two theoretical traditions that rest on opposing philosophical foundations. Wilson's criticism of positivism can serve as an example. Analyzing models in HIB research, T. D. Wilson (1999) explained that one of the reasons for the field's failure to build a cumulative body of research is that, in "the positivist [theoretical tradition], quantitative research methods were adopted that were inappropriate to the study of human behavior" (250).[21] Later in the article he claimed that a model he proposed in the past was limited because "it provides no suggestion of causative factors in information behavior and, consequently, it does not directly suggest hypotheses to be tested" (251–252). Hypotheses are tested, however, to fulfill the conditions required by positivism for genuine knowledge claims. That is, Wilson rejected positivism but at the same time employed one of its doctrines: Any genuine knowledge claim is testable by experience (observation or experiment).

In an earlier essay, T. D. Wilson (1994) noted that "his view of information needs and information-seeking behavior is phenomenological in character" (32). Yet at the beginning of the article he expressed a positivist approach when he reported that he had used the term *information-seeking behavior* "to identify those aspects of information related activity that *did* appear to be identifiable, observable, and, hence, researchable" (16). That is, only identifiable and observable aspects can lead to genuine knowledge claims. This understanding is incompatible with a phenomenological approach. The term *phenomenology* has received several meanings, such as a philosophy, an ontology, an interpretive theory, and a research method framework. Wilson understood it to be a philosophical framework according to which "we need to focus upon human experience of the world, rather than on the world itself and, indeed that the 'real world' should be 'bracketed,' that is, put aside from consideration while we focus on the individual experiences" (Wilson 2003, 447). This latter statement confirms that

phenomenology, in his view, is nonrealist, whereas the positivism he earlier espoused is realist.

Without discussing the various flavors of phenomenology, it is clear that it is in conflict with positivism. Budd (2005), for example, asserted that "Across all conceptions of phenomenology there is a clear and explicit recognition that experience is richer than what our physical senses can apprehend" (45). Patton (2002) elucidated that, for the phenomenologist, "There is no separate (or objective) reality for people. There is only what they know their experience is and means" (106). That is, positivism and phenomenology have opposite ontological stances on reality and therefore cannot reside within the same worldview.

On an abstract level, scholars believe either in the positivist approach or in a nonpositivist one; this belief is fundamental and therefore one cannot shift back and forth between approaches. Similarly, researchers either believe that there is a reality independent of us and that some of it is knowable, or they do not—that is, they are realists or nonrealists—and this belief cannot regularly shift from one stance to the other. Nevertheless, researchers at times employ simultaneously theories from incompatible theoretical traditions.

It seems that the main source for these misconceptions and contradictions is the researchers' notion about the role of a theoretical tradition. All researchers ally themselves with a set of theoretical traditions, whether or not they are cognizant of this alliance. Yet most empirical HIB researchers ignore the role of these traditions in their work. Nevertheless, theoretical traditions can creep in at times, unbeknownst to the researcher. If a researcher selects a conceptual construct to guide his research project, for example, the construct is embedded in a theoretical tradition, and therefore selecting a conceptual construct also means (perhaps unknowingly) choosing a tradition to guide the project.

Researchers often see constructs as helpful tools they can use in a project, rather than as a part of their own conceptual makeup. Some even have developed a research agenda in which they try various conceptual constructs one after the other. Misconceptions and contradictions may occur when a theoretical tradition that a researcher claims to apply does not fit the worldview that guides the project or program.[22] This problem might arise when a researcher has not articulated to himself his worldview, or when he is not familiar with the philosophical roots of the theoretical tradition he is employing.[23] It is not uncommon in such situations for researchers to select trendy theoretical traditions for their investigations.[24] A basic understanding of one's own worldview and the philosophical foundations of individual conceptual constructs is a promising path for avoiding misconceptions and contradictions.

Characterizing one's own worldview in philosophical terms and studying theoretical traditions require a large investment of time and intellectual effort. Is it necessary to invest so much energy just to avoid a few possible misconceptions and contradictions? Are there any other benefits?

8.3 The Role of Theoretical Traditions

Understanding one's own worldview and theoretical traditions offers benefits to both the HIB research community and to the individual researcher. On the community level, discussions about the definitions of basic concepts could be placed in a constructive perspective; an infrastructure for cumulative research and for convergence would be present; and theoretical growth would be supported, as would the distinction between the central and the peripheral. Individual researchers would get support when facing challenging situations and would increase their understanding of research in other theoretical traditions, which in turn would make their communication with other researchers more effective.

Discussions about the definitions of concepts that are basic to information science in general and to HIB in particular—such as *information* and *information need*—were at their peak at the junction between the two generations of research but are not very common today. Scholars seem to have concluded that these discussions did not reach a resolution, and therefore they might as well continue their work and avoid the issue. Indeed, HIB research saw great development and growth without a definitional consensus. It is not clear, moreover, whether a resolution is desirable. Different theoretical traditions may lead to diverse definitions, and unless one advocates a single tradition for HIB, this diversity enriches the research scene. An example of the differences between positivist and interpretive definitions is given in table 8.1.

Table 8.1
An example of two definitional approaches (May 2009)

	Positivist	Interpretive
Information	A real entity that exists independently of human's interaction with it	Something that is created as humans interact with each other and with the world
Information need	A real entity that exists in an actor's mind	An actor's realization that she misses something that is required to move from one situation to another

Consider the definitions of the concept *information* (e.g., Buckland 1991; Bates 2005). In section 1.1.2, I introduced my own interpretation of the concept that was guided by the systems approach[25]—in particular, the requirement that information is for decision making. Others have defined *information* in various other ways—as whatever reduces uncertainty or changes an actor's state of knowledge, or as a social construct, as two examples. All these definitions are "legitimate" and there is no need to find the "best" one. What is missing, however, is an explicit explanation of which theoretical tradition induced each one of them. Knowing the roots of these definitions would demonstrate that there is no one "right" definition, and would afford their harmonious coexistence.[26] A researcher can then select the definition that fits her worldview, while also benefiting from the scholarly work of researchers with other worldviews. A purely cognitive approach, for instance, is incompatible with systems thinking because the cognitive approach is not holistic. As a result, I have not considered, for instance, Belkin's ASK model (see section 3.3.2) as a framework in any of my studies. Nevertheless, the model highlighted the requirement that information systems must support users not only in the retrieval of information but also in crystallizing the information problem a notion that is relevant (and important) beyond the specific model.

One may claim that accepting a diversity of theoretical traditions would stand in the way of creating a cumulative body of research and that this would be disadvantageous to HIB research, which is already highly divergent. A theoretical tradition, however, is a progeny of a worldview. Therefore, to develop a single theoretical tradition for HIB calls for all scholars to share a similar worldview, which is an unreasonable requirement. One unique theoretical tradition for HIB can be suggested only if one incorrectly views theoretical traditions as "neutral" providers of productive tools for research, rather than as embodiments of worldviews. With this approach, scholars can extract from each theoretical tradition the tools that are useful to HIB and put them together to form "the HIB theoretical tradition."

This pragmatic view has been expressed by various scholars. Wilson (2003), for example, recommended phenomenology as a theoretical tradition for HIB because of the "tools" it provides. Similarly, Bates (2005) built her view of information on the "productive metatheory" of evolutionary psychology. Hjørland (2005b) expressed the most pragmatic view (coming from a pragmatist stance) when he required that theoretical traditions be introduced only if their usefulness is demonstrated:

> It is important to emphasize that knowledge about different positions in the philosophy of science is not an aim in itself. If a position has no potential to contribute to the further development of [library and information science] it is principally of no interest to us. ... If a new position

should be introduced into LIS, it should be demonstrated what new arguments this position is capable of contributing compared with arguments that have already been put forward. Also, I claim that if researcher X is influenced by a particular position, then this should somehow be visible in X's publications. If a position makes no visible difference in research output, then this position cannot be said to be important. (156)

It seems, therefore, that having multiple theoretical traditions in HIB is unavoidable. Zwadlo (1997) drew a more sweeping conclusion. Reviewing a few proposals advanced by various library and information science (LIS) scholars who were seeking *the* theoretical tradition for HIB, he argued that the scholars had been promoting theoretical traditions of their choice, but there was no logical way to choose among these competing traditions. Therefore, he maintained, LIS did not have, and did not need, its own philosophy. Bates (2005) also advocated a plurality of theoretical traditions and "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."

One may claim that this diversity of theoretical traditions would prevent the convergence of HIB research. However, the opposite might materialize if HIB researchers understood the various theoretical traditions and their roots. Then, the diversity of traditions could support convergence because scholars would understand the positions of their colleagues and could relate them to their own positions. In fact, the theoretical traditions that HIB researchers follow could serve as the infrastructure for developing a cumulative body of research and bringing a measure of convergence to it. In addition, one may suggest that the various interpretations of basic concepts and the motivation among HIB researchers to introduce new approaches to research and new concepts or phenomena are significant barriers to a cumulative research body (see section 6.4). An open and explicit guidance by theoretical traditions could reduce fragmentation by providing foci around which studies would converge. This way, a new concept or research approach could be connected to existing ones through the theoretical tradition involved. The "Related Literature" section in a research report would address not only the literature on the study's topic, but also the tradition employed through an analysis of other studies guided by it, or of the use of closely related theoretical traditions. Such analysis would point to the multidimensional place of the new study among previous ones. This way, the theoretical traditions could create a network in which research projects would be the nodes.

Generally speaking, knowledge and understanding of theoretical traditions would support the conceptual growth of the field. This growth could happen in several ways. For example, conceptual constructs that have already been created could be associated

with one another through their theoretical traditions, whether similar or different. This association could create a map of HIB constructs that are currently isolated and scattered. The map, in turn, may show current trends and at the same time point to gaps in need of development. Further, researchers who develop new constructs inductively from field studies would be able to place them in one or more theoretical traditions, which in turn will enrich the constructs, since a tradition's foundations might bring new insights and place the constructs in a broad context.

Consider, for example, the concept *information grounds*, that is, "environment[s] temporarily created when people come together for a singular purpose but from whose behavior emerges a social atmosphere that fosters the spontaneous and serendipitous sharing of information" (Pettigrew 1999, 811). Writing later as Karen Fisher (2005), she explained that she drew upon social constructivism to develop the information grounds theory. This alliance immediately points to the social and cultural forces that shape information grounds and the language used to produce this social atmosphere.[27] Investigations in these directions would enrich the theory.

Related to this support, theoretical traditions could help researchers determine what is central to HIB and what is peripheral. For instance, holistic traditions would advocate an important position for context in HIB studies, while reductionist ones would focus on well-defined, clearly isolated aspects of behavior, such as cognitive styles and gender. Clearly, this would not bring about a common notion of what is central to HIB. The differences among the notions and their roots, however, would be understood rather than viewed as idiosyncratic.

The distinction between the important and the marginal would support individual researchers as well when they contemplate what phenomenon to study and what research questions to formulate.[28] Similarly, finding one's own worldview and the compatible theoretical tradition is essential to the development of a sound and consistent research agenda because stable philosophical foundations, rather than trendy research approaches, would guide its development. In addition, having a philosophical self-identity makes it possible to position oneself in relation to other scholars. This awareness, in turn, can improve a researcher's understanding of her colleagues, which would increase the efficacy of interaction with them. As a result, she might gain new insights through learning from others' work by, say, translating new ideas to her own stance, including those ideas that would seem unacceptable at first sight. Further, exploring the fundamentals and nuances of a theoretical tradition would lead to a comprehensive yet fine-grained view of the specific field of study. Such a view would create a structure to support researchers when they encounter challenging situations. This structure would point to possible directions in which solutions can be found.[29]

In summary, attention to theoretical traditions and self-awareness of those that are compatible with one's own worldview would support a systematic and stable development of a rich and diverse conceptual body in HIB.

8.4 Theoretical Traditions in Human Information Behavior: Conclusions

Theoretical traditions from the natural sciences, social sciences, and the humanities have influenced HIB research. Some scholars claim that this plurality stands in the way of developing a cumulative body of research. In fact, it has the potential to create a kernel around which HIB research can converge. Moreover, it is inevitable. Convergence can take place only when HIB researchers are knowledgeable about theoretical traditions and find their own approach. Today, as several scholars have pointed out, most HIB researchers pay no attention to philosophical and theoretical foundations (e.g., Budd 2005; Vakkari 2008). Scholars' disinterest in theoretical traditions is a significant barrier to bringing some convergence to HIB research.

Given the benefits that a community aware of theoretical traditions could offer, why has the situation not changed? Why is the number of researchers who anchor their work in philosophical foundations relatively small? One may claim that the field is still young and has not established itself on the conceptual level. The ever-increasing number of theoretical traditions in the social sciences and the humanities may also be a reason that HIB researchers avoid them altogether instead of constantly keeping abreast of new developments. In addition, because of its short history, information science has not created a culture in which philosophical foundations are of interest. These factors are indeed constraints to the growth of interest in theoretical traditions among HIB researchers.

Another reason for this disinterest is the reward system applied in the academic world, particularly in North America. This domain has turned into a market in which scholars compete for research support and recognition, with productivity used as the basic criteria for promotion and other rewards. The value of scholarly work is measured quantitatively, which encourages an emphasis on the quantity of scholarly output.[30] In the United States, public universities have been thrown into the free market because state support of higher education is on a steady decline. As a result, scholars have the additional responsibility of bringing money to their institutions. Under these conditions, professors are primarily concerned with writing research grants and papers. Given this drive to produce, it is difficult to contemplate and reflect on philosophical issues because this exercise requires much time and does not bring immediate results. Being proficient in the theoretical traditions of HIB would not increase the number

of papers one could write during a given period of time—in fact, it may reduce it—and it is not likely to increase one's chances of successfully competing for a research grant.

To encourage appreciation for philosophical understanding and in-depth conceptual work requires a transformation of the reward system so that a professor's intellectual work is recognized according to its quality and contribution to society, whether through direct or indirect means. While achieving such a system is a worthy goal, its attainment is a long-term project. In the meantime, academic institutions can raise interest in philosophical foundations among future HIB researchers through their doctoral programs, which should include at least one required course in the philosophy of social science. Doctoral studies are the formative years of new researchers, and the best time to develop a scholarly identity. In fact, the responsibility of doctoral students is to develop their individual expertise and approach to scholarship. Being exposed to the various theoretical traditions in social science would support this development and might even generate an interest in them in their future work.

That is, instilling appreciation for theoretical traditions in future researchers is the most promising way for HIB to cope with the lack of interest in philosophical issues among researchers at this time. Such an appreciation may further the conceptual growth of HIB as well as its convergence.

IV Human Information Behavior and Systems Design

Research projects in human information behavior (HIB) have often claimed to offer contributions to HIB research, to practice, or to both areas. Contributions to research typically occur in the following forms:

- developing conceptual constructs that would guide research
- checking how such constructs from other fields can be employed in HIB research
- discovering the factors (or variables) that need to be considered in HIB research.

Studies intending to contribute to HIB practice try to help improve information behavior. They may focus on various goals, such as

- improving the context in which people operate through organizational and social changes
- improving training
- improving the design of systems and services that support and enable HIB.

This part of the book addresses the ways HIB research can contribute to the design of information systems. This discussion leads to the introduction of cognitive work analysis. While the focus here is on computer-based systems, the principles discussed are applicable to any type of information system.

9 Interlude: Models and Their Contribution to Design

Every design is informed by some representation of a section of reality. That is, the design of all artifacts, whether a chair, a bridge, an airplane, or an information system, is informed by some kind of model. The models can be presented in various forms, such as blueprints, pictures, or narrative descriptions. In addition to their form of presentation, models can be classified by other categories. Some of these classifications can help uncover which models are most beneficial for design.

9.1 A Typology of Models

Models have been classified in various ways—by their form, for instance, as abstract, conceptual, graphical, and mathematical models; or whether they are domain-specific or universal models. One typology that is relevant to design was presented by Vicente (1999, 6–8), and was based on Rasmussen's (1977) work. It categorized models according to what they represent: how things are, how they should be, or how they could be (i.e., what the possibilities are):

Descriptive models describe actual behavior.

Normative models prescribe what behavior should be.[1]

Formative models describe requirements that must be satisfied so that behavior takes place in a new, desired way.

To demonstrate the differences among these types of models, consider the following scenario. Mary is visiting Monterey, CA, and staying in the Casa Munras Hotel (bottom left in figure 9.1).[2] It is a hot day, and she wants to go to the beach. But this is her first visit, and she needs to ask the concierge, John, how to get to the beach (top right in figure 9.1). John can help her in three ways (among others):

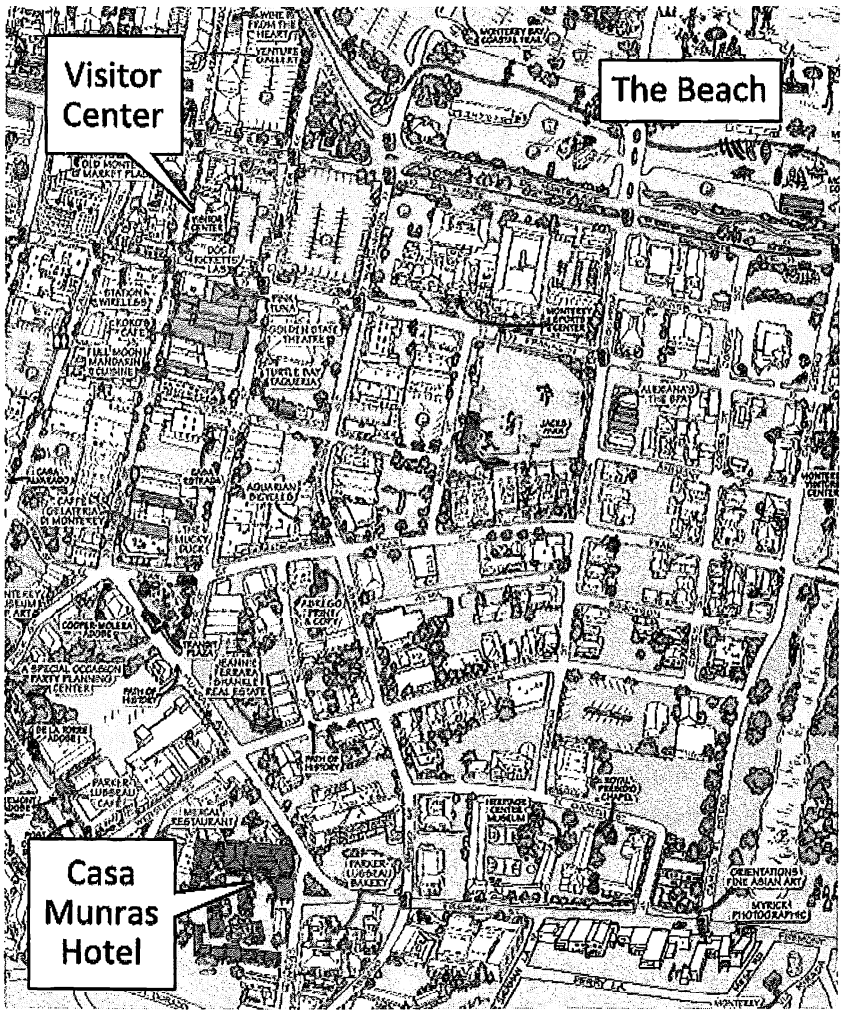

Figure 9.1
A section of a Monterey, California, tourist map. *Source*: http://mappery.com

a. He may give her directions by describing the route that people usually take. That is, John could present Mary with a *descriptive model.*

b. He may give her directions that he thinks are the best. Or, he may give directions to the most scenic or sun-sheltered routes. That is, John could present a *normative model.*

c. He may give Mary a map. Looking at the map, Mary can see the possible ways to get to the beach, and choose one of them. In this case, John would present a *formative model,* showing Mary the routes she can take—the possible ways to get to the beach.

Getting directions (whether descriptive or normative) requires Mary to invest very little cognitive effort: John has already discovered the route most people take, or the best ones, and she just needs to follow his directions. Using a map, on the other hand, would require that she make decisions in order to select the desirable route. A map, however, would give Mary much more flexibility. She could deviate from her planned route if she spotted a place of interest that is not on the route, and then find a new way to get to the beach, one that would not require a return to the original plan. This flexibility is not available with directions, as every deviation entails backtracking to the original route. With a map, Mary can see the possible routes to the beach and may decide to change her route daily to see more of the city's views. Having all possible routes in front of her, she can choose the daily one according to the weather: going along the water on very hot days and through covered streets when it rains. Moreover, if one day Mary decides to go to the Visitors' Center, she would not need any new directions; she can figure out the route herself. In fact, with the help of a map she can get to any destination within the city limits from any site she is visiting. Therefore, getting directions is helpful for visitors who stay in a place for a short time or for those who prefer to relax without having to make any decisions. Other visitors are likely to find a map more useful.

This example shows that each model a tourist receives of the road from a hotel to another destination would shape the day the tourist would design.

9.2 Types of Models and Their Contribution to Design

To examine the contribution of models to design, it is useful to expand the concept *model* to include other constructs which, according to their creators, inform design, regardless of their form, such as information-seeking behavior (ISB)

research reports. Thus, the term *model* is construed here as any construct that is a representation of reality and that has been created to inform the design of information systems.

Using the typology above, an ISB model that is handed to a designer of a new system can (1) describe how seeking is being carried out currently, (2) describe how seeking behavior should be, or (3) present a "map" of the "seeking behavior terrain" and ask the designer to create the best system possible, given the constraints of the terrain and current technology.

In what way can each of these three types guide the design of information systems?

9.2.1 Descriptive Models

Descriptive models are very useful when one wants to examine how people look for information. Indeed, most ISB studies are descriptive: They report how people behave when they seek information. The strength of descriptive empirical studies, and in particular naturalistic field studies, lies in their potential for providing a solid basis for the development of theories and models. Chatman (2000), Kuhlthau (2004), and Nahl (2007) have formed outstanding examples out of this potential. At the same time, they do not provide a sufficient base for the design of information systems because they describe *current* behavior. Descriptive models cannot predict the new behavior that will replace the current behavior when a newly designed system is put into operation. But this new behavior is the one according to which the new system should be designed.[3]

This problem with descriptive models is manifested in various ways. Most important is the fact that seeking behavior is tied to existing technology, and therefore using a descriptive model as a base for the design of new systems is not useful for two reasons. First, part of seeking behavior is determined by the limitations of the current system—for which users find workarounds to get desired results. As Vicente (1999) explained: "Analyses of current practice lead to design ideas for supporting this practice" (100). Recording observed behavior, researchers may recommend that a workaround behavior be supported by the new system, which is clearly undesirable. Second, the value of a new system lies in whether it offers new and better possibilities. An analysis of current behavior alone cannot point to new possibilities of any value because they do not exist in the current configuration. The best such analysis can do is to point to problems in the current user-system interaction, and this feature is indeed one of its strengths. But the solutions to these problems cannot be generated only from the description of current seeking behavior.[4] Other types of analyses are required for that purpose.

9.2.2 Normative Models

It seems sensible to assume that normative models of searching behavior are ideal for guiding design because they prescribe the "right" behavior, and thus that systems should be designed to support and encourage this type of behavior.[5] One of the weaknesses of norms, though, is that they are based on rational behavior. To employ a normative model in support of systems design entails the assumption that people behave rationally (according to some universal standards) when they use systems. Yet research has shown that this ideal behavior is frequently not the case. Chatman's (1987) participants, for example, avoided information that could have helped them solve vital life problems, and high school students searching the web employed only the browsing strategy, which was inefficient and frustrating to them (Fidel et al. 1999). The validity of the rationality assumption is the main shortcoming of the normative model as a prescription for design.

Normative models might not be useful for the design of information systems, in particular for information retrieval (IR) systems, for several other reasons. Information-seeking processes, and information retrieval processes in particular, are complex and dynamic. In contrast, establishing norms requires some level of reduction or averaging, which limits the usefulness of these models in representing complexity. As a result, normative models can provide only a reduced representation of the search process or one that is highly abstract and thus not useful for design.[6] The dynamic nature of a search is caused by the unanticipated developments along the way. Normative models can prescribe behavior only in cases of anticipated situations because norms can be established only on known circumstances. Therefore, they cannot represent the dynamic side of a search.

Consider Taylor's (1968) normative model that represents which questions librarians should use to interview a user to understand her query and in what order they should use them (see section 3.3.1). The order of the questions is a central norm because each question is informed by the previous one, beginning with the determination of the subject of the query and concluding with the anticipated answers. Theoretically, a machine could be designed to help users crystallize their queries by presenting appropriate questions in the right order, following Taylor's model,[7] assuming that users crystallize their queries rationally, following the stages in the model. Yet such a machine would leave unhappy the users who need help the most. A user who has ready responses to the questions posed during the interaction, and in the right order, probably can formulate the query on his own. The user needing help is the one who knows only, say, what answer she anticipates (the last question), but cannot be specific about the subject (the first question). Our machine, alas, cannot

help her because, following Taylor's order, it needs to have the subject of the query recorded before any other interaction can take place.[8]

Normative models guide the design of a system that supports the "best" way to perform a search, but, at the same time, they make other approaches impossible to employ. Therefore, while design based on normative models may help users to avoid mistakes in searching, it restricts a searcher from employing creative ways of searching that at times might be more productive than the normative way. Moreover, because the way to search is prescribed a priori with such systems, searchers cannot improve their searching skills or learn how to search. This limitation will reduce their capability to resolve unanticipated developments in the search process, which, in turn, would affect the quality of the results.

Detailed normative models, of the type that is necessary to guide design, inevitably are dependent on the retrieval technology used. For instance, the "right" way to search with current web search engines is different from the "right" way to search retrieval systems with relevance feedback.[9] Therefore, when a search engine designer wishes to add a relevance feedback device to his web-based product, a model that prescribes how to search the old system is not likely to be useful.

In summary, neither the descriptive model nor the normative model is useful for guiding the design of information systems by itself because of its dependence on the existing technology and its limitations in preparing a system for unanticipated and complex situations. While descriptive models offer understanding of current behavior, which is useful for design, normative models can be useful only for the design of simple systems with a limited set of capabilities.

Before we leave these models, we should make one further observation. Both types of models represent procedures, or specific activities. HIB studies, for example, describe procedures such as how people analyze their information problem, select information sources, exchange information, search the web, and evaluate search results. Procedures are dynamic, however, and can change with even small changes in circumstances and with slight modifications in the technology. Paradoxically, design that is based on the description of current procedures will inevitably result in new and different procedures. But these procedures will not be supported by the new system, which was designed around the old procedures. As a result, the new system is likely to become outdated shortly after its implementation.

One of the ways to resolve this situation is to consider *categories* of procedures, which are more stable than the procedures themselves, and can be selected so that they are independent of technology. For instance, instead of investigating the specific interaction between a searcher and a search engine, step by step, we may want to

identify the search strategies that have been employed (e.g., browsing, analytical search).[10] Vicente (1999)—based on Rasmussen (1981)—provided a useful definition for a strategy: "a category of cognitive task procedures that transform an initial state of knowledge into a final state of knowledge" (220). Whereas the interactions with a search engine, as well as its procedures and activities, are likely to change when a new search engine is installed, the strategies will stay the same because they are independent of the technology,[11] even though they may require new procedures for their application in a new system (hopefully simpler and more productive ones). The procedures people follow when they browse library shelves are dissimilar to those employed in web browsing, but mentally, people use the same strategy. Looking at categories, an information system would be designed to support browsing, and each new version would make available procedures that users' circumstances dictate and technology affords. Descriptive models alone cannot support this approach to design.

9.2.3 Formative Models

In contrast to descriptive and normative models, formative models offer the foresight required for future design because they represent the possible ways in which information-seeking behavior could take place, whether or not they occur currently. Moreover, they can lead directly to the formation of design requirements.

9.2.3.1 Constraints-Based Formative Models

One may claim that while, in theory, the idea of formative models and their contribution to design makes sense, such models are not likely to be practical. How can researchers predict all possibilities or know what seeking behavior may occur in the future when a new system is in place? As stated, this task is indeed impossible.

To demonstrate how a formative model can be constructed without enumerating all the possibilities, but representing them nonetheless, we return to Mary who is visiting Monterey, using the map John gave her.

With a map—which is a formative model of the city—Mary is free to design a route from every place in the city to another, because the map lays out all the possible routes. How can Mary make out all the possible routes? Obviously, the clear marking of the streets presents the standard (or normative) routes to her destination. But the map also suggests other possibilities, such as cutting across a parking lot or a small park. An even more detailed map, one that marks the entrances to buildings, for instance, could have suggested the possibility of shortcuts that would eliminate the necessity of going around a block by entering a building, say, through the front entrance and exiting through the back door.

In fact, any area that is not blocked for passage can be a segment in the route from the hotel to the beach. The best way to present all the possible segments is by presenting what is blocking the way, that is, by presenting what limits movement—i.e., the constraints. Mary can then choose the route that fits her agenda for the day from among all the possible routes, whether standard or "deviant."[12]

We can consider a city map, then, as a layout of the constraints associated with moving around the city. In other words, a map shows the possible routes from one location to another by displaying the constraints to these routes. With this approach to the construction of a formative model, the possibilities are represented by laying out what is *not* possible. That is, to model what *could be* requires first the identification of what *could not be*. This approach to design is called *constraints-based design*.

In ISB, a formative model can be constructed by representing the constraints on information seeking.[13] While taking the approach of cognitive work analysis (CWA) leads to the creation of a constraint-based model, there are very few formative models in the field of HIB.[14] One example is a study conducted by Martin Rose (2006) which investigated the "information activities" of passenger information officers (PIOs), that is, staff that provided information to passengers at the command and control center of a rail network. Through observations and interviews he uncovered both the constraints (e.g., dynamic environment, time pressure, information shortage, and pervasive uncertainty) and categories of information activities (e.g., monitoring network status, investigating service disruptions, and relaying information to operational staff). His analysis then produced a set of requirements that specified what activities the system should support. The requirements included: "Allow communication tasks related to different audiences or different channels to be separately allocated to different PIOs," and "allow PIOs to freely allocate and reallocate communication tasks between each other as situations change, without losing any of the work completed" (Rose 2006).

An earlier constraints-based approach was developed by Mick, Lindsey, and Callahan (1980), who were concerned about the gap between information behavior studies and the design of information systems. To build up the approach, they had created a conceptual framework that guided a questionnaire-based study of scientists and engineers in a corporate environment. The framework addressed the environmental, organizational, role, and task constraints. The resulting model, which was adequate to guide system design, was validated through various tests.

Not all constraints on seeking behavior are relevant to the design of information systems. For the purpose of system design, only those constraints that shape seeking

behavior are pertinent. There is no magic formula that can be used to distinguish such constraints from the irrelevant ones, and in fact, the role that constraints play may change from one context to another. Therefore, the discrimination between important constraints and insignificant ones is best achieved through an in-depth study of the seeking behavior of the actors for which the system is designed and their environment. From a practical aspect, formative models should represent only stable constraints. For example, the seeking behavior of the PIOs in Rose's (2006) study might have been affected by the character and temperament of their manager. Yet managers come and go, particularly in this era of frequent reorganizations. If one considers this constraint as a basis for system requirements, a new information system would have to be designed for each incoming manager, which is impractical. That is, according to this approach, a formative model represents *stable* and *behavior-shaping* constraints. Stable constraints are called *invariants*.

Constraints-based design is a relatively new approach in the world of design, and documents describing the process of translating constraints into requirements are hard to come by. This scarcity is not surprising because, in addition to being new, the translation process itself is complex, due to the complexity inherent to real life, which requires the design of real-life information systems to consider a complex network of constraints.[15] A simple example from my own experience may suggest how such a translation can be prepared. In a study of engineers searching the web for their daily, job-related work (Fidel and Efthimiadis 1998), we observed that our participants planned their searches, and even displayed help screens to guide them in this process. In addition, they were disappointed that they were unable to predict the results. These observations highlighted one of the constraints we had identified earlier in the study: the type of education and training engineers received which had shaped their professional thinking. These observations validated our commonsense assumption that engineers plan before they act, that they are methodical and analytical in their work and prefer to understand what effects their moves and actions would have. This constraint then gave birth to the requirement that the system support planning web searches and predicting results. It also pointed to other requirements that were not based on observations, such as supporting systematic and structured ways of searching, and increasing the visibility of the retrieval mechanism. In time, and with technological developments, engineers may create new ways to plan their searches and to predict the results, but the nature of their education and work, which has trained them to be methodical and analytical, is not likely to go through radical changes in the near future.

Being stable and shaping behavior are not inherent attributes of certain constraints. Each context has its own set of such constraints, and a constraint that is stable and behavior-shaping in one context may not be so in another. It is the role of the HIB researcher to find such constraints in the context under study. This goal is usually achieved through naturalistic field studies that aim at describing *both* the current behavior (a descriptive model) and the constraints that shape it (a formative model).

9.2.3.2 The Advantages of Constraints-Based Design

The formative model overcomes several shortcomings of both the descriptive and normative models. By definition the formative model provides a full representation of possible behaviors, whereas descriptive models represent only current possibilities and normative models must rely on simplified and reduced representations. Uncovering the possibilities also reveals ways of seeking that are not currently employed, some of which might be productive and enjoyable. Because it represents constraints rather than current procedures, a constraint-based design is not guided by workarounds or current practice that may change with the new system. It also does not have to be based on any universal assumptions about the way users behave—e.g., people behave rationally—thus avoiding erroneous assumptions. A system that is designed to support possible behaviors has many advantages; most notably, the changed behavior that the new system brings about will be supported without the need to know ahead of the design the specific shape it will take. The system will also help a user stay on track despite unanticipated circumstances because it can support the behavior that new circumstances require. This way, a formative model can lead to the design of adaptive systems.

One may claim that a design guided only by stable constraints is likely to limit the possibilities for the user, resulting in a static system. Such limits will indeed be the case if the dynamic constraints are completely ignored. Constraints-based design, however, can provide affordances to behaviors that are shaped by changing constraints even when it is guided by stable constraints. An example may illustrate how formative models can guide the design of adaptive systems. The mCity project (e.g., Fidel et al. 2007) investigated the use of mobile technology to support field work in the Drainage and Wastewater Department of the City of Seattle. Workers in the department, who were responsible for keeping the city's drainage system in working order and responding to breakdowns, received their work orders for the day on a hand-held computer the size of an average book, which they could carry and use at any time and in any place. Some difficulties occurred on days when work orders were given for several sites

in different locations. The following are some of the stable, behavior-shaping constraints we found that are relevant to these difficulties:

- Workers aim at an efficient and effective use of their time, and thus prefer to sequence work locations according to the physical proximity of the relevant sites.
- The first or the last location for the day should be close to their base.
- Around lunch time they need to be near an enclosed space in which they are allowed to eat despite their often dirty uniforms.
- At some point they may discover that they need to postpone work in some locations because of unanticipated complications in previous locations or because they need to get additional equipment when they discover new problems in the site.

These constraints point to a requirement: The system should facilitate visible and flexible work-order scheduling. Because of its size, the hand-held screen could only display information about one location at a time. Without being able to see all the work orders on one screen, workers had a hard time scheduling their site visits or rescheduling them when necessary. There are at least two approaches to resolving this difficulty. Given the technological constraints (e.g., the small screen) and ignoring the particular conditions in the field, the department's work flow could be modified so that the back-office schedulers, who assign the work orders to a team and work with large screens, arrange the work orders in a sequence that fits these constraints.[16] In this case, field workers could safely follow the sequence assigned to them. This solution is not ideal because workers have the same difficulties as before when facing unanticipated complications that require rescheduling; that is, workers would not be able to benefit from the information in the system when facing unanticipated situations, or when a completely new situation arises.

A different approach—and one that affords behaviors that are shaped by dynamic constraints—is to provide various facilities that make it possible for the workers to easily schedule and reschedule the work orders for which they are responsible. This capability could be implemented in various ways, such as by providing easy communication channels with the schedulers, adding access to paper printouts (e.g., of addresses and maps) while in the field,[17] or providing easy access to various types of information to support decisions. When such facilities, and possibly others, are provided, workers can consider the situational factors they face (i.e., the dynamic constraints), select a facility, and use it in a way that best supports making a decision in specific work situations. That is, the system makes it possible for the workers to adapt to changing, situational circumstances or to unanticipated ones. In such cases, the workers "finish the design" (Vicente 1999).

An example from the BookHouse system for fiction retrieval in schools and public libraries may illustrate adaption to changing, situational circumstances. Annelise Mark Pejtersen (1984, 1989, 1992) created a constraints-based model of fiction searching behavior through the analysis of over 100 user-librarian conversations. She then developed a fiction retrieval system based on the requirements that had been derived from the analysis. A searcher could choose the strategy to employ (and easily shift from one to another);[18] when employing the analytical strategy, for example, she could retrieve books according to various facets, such as author, title, graphics on the book cover, names of the central characters, the setting of the plot, the genre, and the nature of the experience. When a book is selected, the information that is displayed on the screen includes all the facets. For example, in addition to finding a list of the character's names, a searcher may discover that the selected book has icebergs and whales on the cover, that the story took place in the 1980s, and that it is a novel with happy ending.

One of the strategies a user of the BookHouse system could employ is the similarity strategy, according to which she enters a book title as an example of the kind of book she desires and asks the system to find similar books. The system then displays 10 books through which she can browse and hopefully find one that she likes.[19] This is the straightforward use of the similarity strategy. But the system also afforded productive searching when unanticipated situations arose. If while browsing the 10 books, the user found another book she had read that would be a better example of the kind of book she wanted, she could enter this book as an example, which would generate a new search using the similarity strategy. Or, while scanning the facets for a book, the user might realize that she liked the example book because it was an animal story from the 1980s that was both exciting and sad—a desire she could not articulate before. She could then directly click on these terms on the book display and retrieve the books satisfying these requirements. Thus, while the similarity strategy is based on a stable constraint (a user can find a "good" book only with the use of an example), the system enables searching under dynamic constraints. In this case the system adapted to an unanticipated situation when the reader finished its design by using it in a new way.

Constraint-based systems are thus designed to adapt to actors in the sphere of stable constraints (invariants), and to make it possible for actors to adapt in the sphere of situational constraints.[20] Formative models are not always required for system design, but they are necessary for the design of complex and dynamic systems—that is, for the design of information systems.

9.3 Models and Their Contribution to Design: Conclusions

What a model represents also determines how it can contribute to design and to what degree. By and large, there is no evidence that ISB researchers have considered this factor or how their models could contribute to design. Is it possible, then, for ISB models to inform the design of information systems? If it were possible, would the current IR researchers' common approach to design be open to being informed by them? These questions are discussed in the next chapter.