DESIGNING THE SEARCH EXPERIENCE

THE INFORMATION ARCHITECTURE OF DISCOVERY

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CHAPTER

Information Seeking

2

> Every one has daily, hourly, and momentary need of ascertaining facts which he has not directly observed.
>
> — *John Stuart Mill*

Mankind is an endless pursuer of knowledge. Philosophers and scientists through the millennia have gathered in libraries and universities to investigate the inner workings of our world; yet there is also a humbler, more pragmatic form of inquiry at work in every individual.

Whether planting vegetables, repairing a car, or building software, individuals regularly need access to information that they don't yet possess. We bridge this knowledge gap by asking those around us for advice, turning to books and encyclopedias, and, increasingly, searching the Internet. This journey between need and fulfillment is called *information seeking*.

We begin the chapter by exploring the evolution of information seeking from that of a *system*-oriented model at its inception, to today's *user*-centered perspective. We then examine two forces that mediate the information seeking process—information foraging and sensemaking—before climbing to higher ground and recasting information seeking as a long-term, multistage activity.

MODELS OF INFORMATION SEEKING

Designing effective search experiences requires not only an awareness of users' cognitive characteristics, as we explored in Chapter 1, but also a clear understanding of how users go about seeking information (Hearst, 2009). Our conception of this process has evolved over the years from simplistic and static to complex and dynamic. Five models have particularly shaped our understanding along the way, starting with the classic model.

FIGURE 2.1 The classic model of information retrieval.

The classic model

The *classic model* is one of the first models of information retrieval, widely used in information science research for over 30 years (Robertson, 1977). At its core is the action of the search engine, which matches information needs expressed as queries with documents represented by entries in an index (Figure 2.1). Influential though it may have been in its day, this model overlooks the most important element of information seeking: the user. To design effective search experiences, we need models that place the searcher rather than the system at the heart of the process.

The standard model

In contrast with the classic model, the *standard model* places greater emphasis on the user. It portrays information seeking as a type of problem solving (Marchionini, 1995) involving a cycle of four activities (Sutcliffe & Ennis, 1998):

1. Identifying the problem
2. Articulating the information need
3. Formulating the query
4. Evaluating the results

These steps are illustrated in Figure 2.2. Starting with the task at hand, the user articulates an information need that is expressed in verbal form as a query. The query is then matched by the search engine with documents in the collection. This step returns a set of search results that the user then evaluates, refining the query as appropriate. The cycle is repeated until the information need is satisfied.

The cognitive model

Like the standard model, Don Norman's *cognitive model* of task performance (shown in Figure 2.3) also views search as a form of problem solving driven by an explicit user goal (Norman, 1988). But in this case, users apply a *mental model*—an internal representation of the problem situation and its context—to develop a plan of action to achieve that goal. These actions lead to changes in the external world that are evaluated to determine whether the goal has been achieved.

In the context of information seeking, the "execution of actions" corresponds to articulating the query, "changes in the world" to updating the set of matching documents, and the "evaluation" of these changes to reviewing the search results. The gap between the

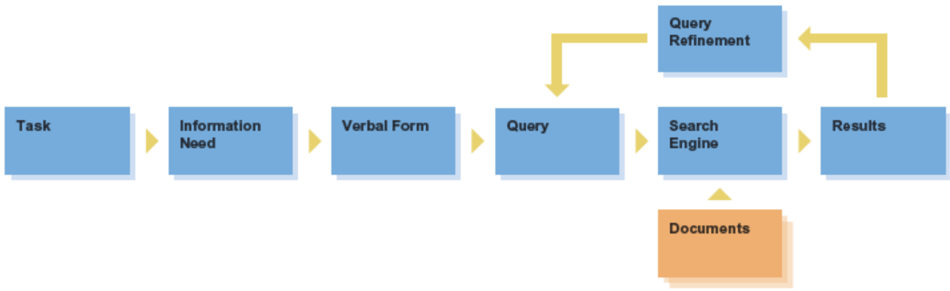

FIGURE 2.2 The standard model of the search process.

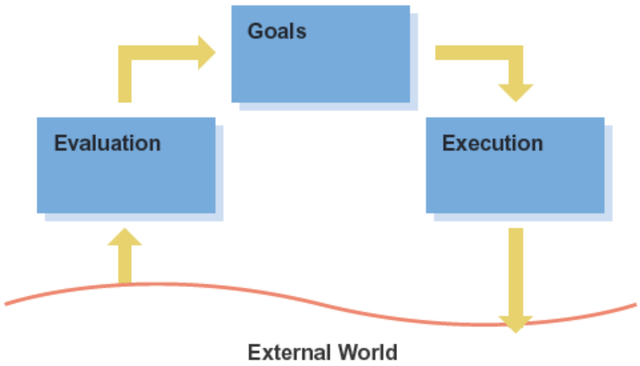

FIGURE 2.3 Don Norman's cognitive model of task performance.

intended result and the actual result is described as the *gulf of execution*; the challenge of determining whether the goal has been achieved is described as the *gulf of evaluation*.

A key insight of Norman's model over the previous two is that it recognizes the importance of domain knowledge (as discussed in Chapter 1): the greater the users' knowledge, the more likely they are to articulate effective queries and accurately determine the relevance of results.

The dynamic model

Both the standard and cognitive models share an underlying assumption that the user's information need remains unchanged throughout a given session. They view the process of information seeking as one of iteratively refining a given query until the ideal set of results is found. However, numerous studies have found that users' information needs evolve as they interact with information and that they formulate new goals as they acquire domain knowledge. Far from being static, search is an interactive, iterative process in which the answer can change the question. As Peter Morville puts it, "what we find changes what we seek" (Morville, 2009).

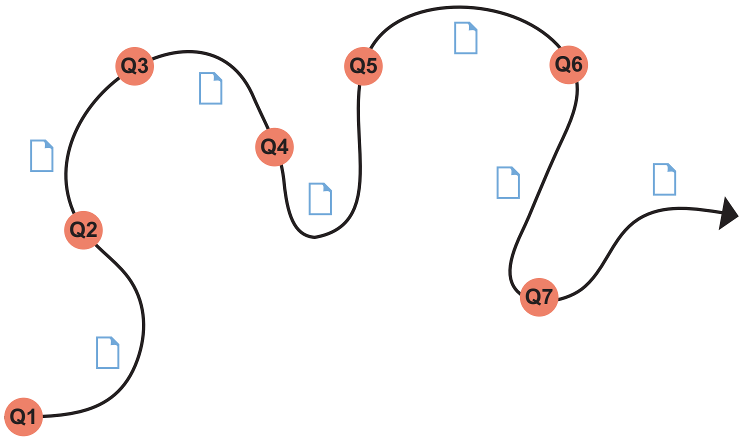

FIGURE 2.4 Marcia Bates' dynamic model.

Consequently, we need a model that accounts for changes in users' information needs as they learn and respond to the information they encounter. The *dynamic model* proposed by Marcia Bates (1989) accomplishes just that (Figure 2.4).

The dynamic model compares the information seeking process with the act of picking berries in the forest. It recognizes that interacting with information can trigger the formation of new, unanticipated goals, which in turn lead to the formulation of new queries and new directions for the search process. It also acknowledges that the user's information need is not satisfied by a single, ideal set of documents, but—like an animal foraging from one berry bush to another—by an aggregation of learning and insight gathered along the way. In this model, search is not a quest for the perfect document but a conversation that helps us understand the right questions to ask.

The information journey model

Others have built upon the insights of the dynamic model. In particular, Ann Blandford and Simon Attfield (2010) have further explored the unfolding journey of information seeking. Like the dynamic model, their *information journey model* (shown in Figure 2.5) has been derived from empirical studies of user behavior. The main activities in their framework are:

1. Recognizing an information need
2. Acquiring information
3. Interpreting and validating the information
4. Using the information

Superficially, these steps may appear similar to those of the standard model. But in spirit, they are closer to the dynamic model and its emphasis on validation, interpretation, and use of information as the key activities shaping the evolution of the information need.

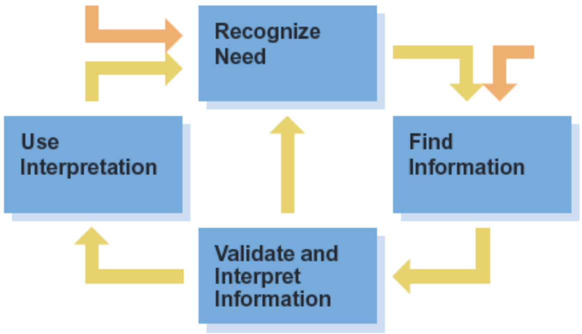

FIGURE 2.5 The information journey model.

This framework also embodies a further key property. In each of the previous models, information seeking is assumed to be an active process, triggered by the conscious recognition of an explicit need. However, there are occasions when information is presented to us without our having actively sought it—the chance encounter, the unexpected insight, the fortunate discovery. These information encounters are what we commonly label *serendipity*. The information journey model, with its multiple entry points, acknowledges serendipity as part of the information seeking experience.

INFORMATION FORAGING

Moving from a static understanding of the user's information need to a dynamic, ever-evolving need highlights the importance of iterative querying and browsing. But if information seeking is a journey, what rules of the road regulate the user's voyage from initiation to completion?

The guiding forces of information seeking are both surprisingly primitive and uniquely human. *Information foraging*, an instinct closely related to that found in animals hunting for food, interacts with *sensemaking*, the cognitive process for deriving meaning from new information. Together, information foraging and sensemaking form a feedback loop (Pirolli & Card, 2005) that underpins the information seeking process.

A biological foundation

Biologists in the 1960s observed that animals often eat a particular type of food in one environment but ignore the same food in other places. Ecologists Robert MacArthur and Eric Pianka set out to discover how animals decide what to eat. Their research, and their accompanying *optimal foraging theory* (MacArthur & Pianka, 1966), provides a foundation for understanding our own behavior when searching for information.

According to optimal foraging theory, animals live in environments consisting of many "patches," each with a unique blend of potential food sources. An Alaskan black bear, for instance, might frequent the prairie for grasses, ants, and small rodents; visit the river for fish and to hunt deer; and enter the forest for berries, leaves, and nuts.

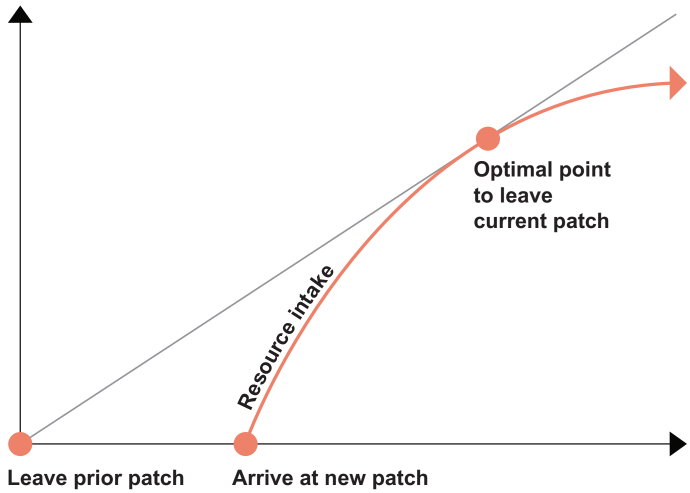

FIGURE 2.6 Charnov's marginal value theorem states that a forager should leave a given patch when the rate of gain within that patch drops below the rate of gain that could be achieved by traveling to a new patch.

When a bear arrives at a new patch, it gravitates toward the most filling food that requires the least amount of effort to consume. Over time, however, the patch dwindles in value as the bear has to work harder for ever-decreasing amounts of food.

This principle of diminishing returns is known in ecology as the *marginal value theorem* (Charnov, 1976). The theory asserts that animals perform a cost/benefit analysis on staying in the current patch versus traveling to a new one—considering both current and potential food supplies as well as the transit time between the two patches (Figure 2.6). Although this occurs at an instinctive rather than cognitive level, studies have confirmed that animals are remarkably accurate judges of when it's best to switch patches (Pyke, Pulliam, & Charnov, 1977).

Man the informavore

Bears aren't the only creatures who are effective foragers; we're pretty good at it ourselves. Unlike animals foraging for nuts and berries, however, we forage for information. George Miller portrayed our species as *informavores*: creatures hungry for information (Miller, 1983). But just like the bear must be selective in its diet (digging all day for a few measly ants would hardly be worthwhile), so must informavores carefully navigate the glut of information in our modern environment. Herbert Simon spoke of this perilous balance in 1971:

> What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the over-abundance of information sources that might consume it. (p. 40)

Although information is what we seek, our limited supply of attention forces us to make a tradeoff between comprehensiveness and timeliness. Simon coined the term satisficing—a combination of the words "satisfy" and "suffice"—to describe this pragmatic decision-making strategy that pervades human behavior (Simon, 1956).

Information foraging theory

Peter Pirolli and Stuart Card, researchers at the Palo Alto Research Center (PARC), began applying the principles of optimal foraging theory to information seeking in the early 1990s, establishing a new framework called *information foraging theory* (Pirolli & Card, 1999). Pirolli and Card drew a connection between users moving from one website to the next and animals traveling from patch to patch. They observed that users, in an effort to satisfice, heavily rely on certain cues known as *information scent* to guide them toward their destination.

As users traverse the Web, they encounter information scent when "trigger words"—terms they perceive as meaningful to their task—are used in the text of a hyperlink, as words in a heading, or in a search result's description. The more trigger words that are present, the stronger the information scent (Spool et al., 2004). When information scent grows stronger from page to page, users are confident that they're headed in the right direction. But when it's weak, they may be uncertain about what to do or even give up.

In addition to information scent, Pirolli and Card's research also helps explain *information snacking* (Nielsen, 2003). According to the marginal value theorem, the amount of time a user spends on a given website is proportional to the travel time *between* sites. As between-patch time decreases—thanks to Google and fast Internet connections—users spend less time on any one site. The result is that information seeking has become less of a sit-down banquet and more of an opportunistic buffet.

Designing with information scent

Although the behavioral similarity between omnivorous beasts and man the informavore is striking, information foraging is as practical as it is fascinating. Information scent provides valuable carrots and sticks to guide users through the iterative process of information seeking. Next, we'll look at three basic but important techniques for putting information scent to work in search user interfaces: descriptive titles, hit highlighting, and clear labeling.

Descriptive titles

Before clicking on a search result—or even reading its two-line description—the title must first be deemed relevant. Obvious though it is, the presentation of clear, descriptive titles is the surest method for providing strong information scent when displaying search results. Yet doing so is often more difficult than it sounds; untitled and cryptically named documents abound. Some forgiving search applications make up for human sloppiness by extracting metadata, analyzing the text of the document, and piecing together a title that accurately describes what the document is about.

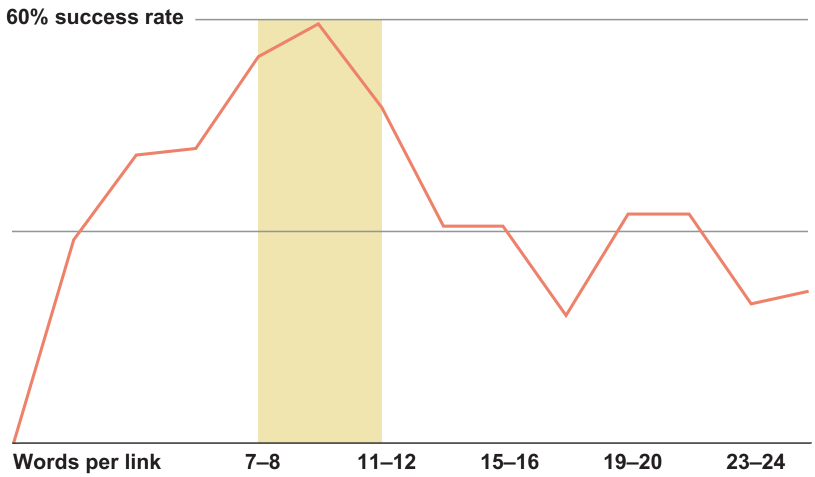

FIGURE 2.7 Jared Spool found that 7- to 12-word links yield the greatest likelihood of a user finding what he or she is looking for.

Usability advocate Jared Spool found that information scent is strongest when links accurately describe the page they represent, are free from jargon and marketing slogans, and feel clickable (Spool et al., 2004). He also found that reasonably long titles tend to work better than shorter ones, with links of 7 to 12 words being most likely to lead to a successful outcome (Figure 2.7). Although the meaning of the words used is obviously more important than the number, longer titles increase the likelihood of trigger words appearing, thus boosting information scent.

Hit highlighting

If the title of a search result seems promising, the user may then decide to direct his or her attention to the result's description. As with titles, human-provided descriptions are often insufficient. Fortunately, most current search engines dynamically extract an excerpt from what they deem the most relevant portion of the document. Yet *hit highlighting* can increase the information scent of the excerpt further still (White, Jose, & Ruthven, 2003).

When the user performs a query, he or she inputs the most important terms to his or her search—that is, the query's trigger words. Hit highlighting (Figure 2.8) is the technique of emphasizing the words included in the query wherever they appear on the search results page. Using a bold font weight helps to draw the user's eye to the trigger words, increasing information scent.

Clear labeling

There are often just a handful of categories that are significant to the user's current task. When searching through online content, for instance, the user might be looking for business news and wish to skip over sport and entertainment articles (Figure 2.9). Clearly

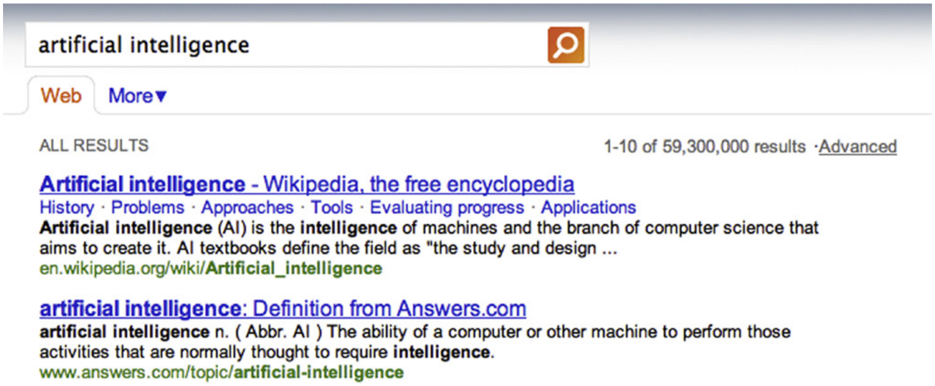

FIGURE 2.8 Bing uses a bold font weight to highlight the user's query terms whenever they appear in the search result list, for both exact phrase matches (e.g., "artificial intelligence") and partial matches (e.g., "intelligence").

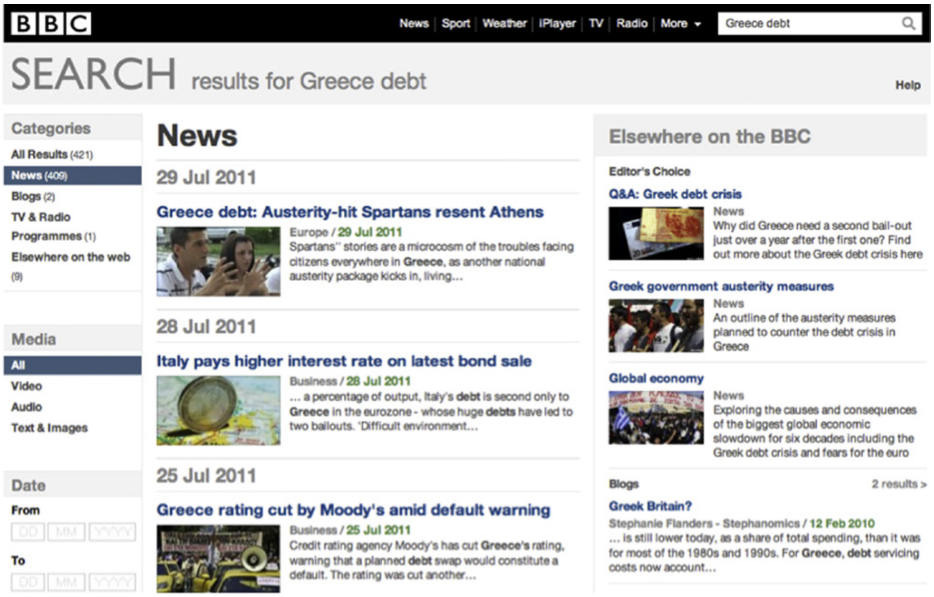

FIGURE 2.9 The BBC labels each news story with a category, such as "Europe" or "Business."

identifying which category a given result belongs to can help users ignore unwanted documents and focus on their genre of choice (Drori, 2002).

Like our animal friends, we human foragers follow our noses. Our ingrained instinct to satisfice—to sacrifice the "perfect" for the "good enough" in order to conserve mental resources—has resulted in fast-paced skimming, speed reading, and jumping from one web page to the next as we follow the scent of information. By crafting search user interfaces with optimal levels of information scent, designers can reduce the mental effort users must expend to find what they seek.

SENSEMAKING

Information foraging helps users drown out the noise and tune in the signal. But finding relevant information is only half of the equation; users must also make sense of what they encounter.

Sensemaking—a concept developed in the information science field by Brenda Dervin (1983) and in human–computer interaction by PARC researchers Daniel Russell and colleagues—describes the process through which people assimilate new knowledge into their existing understanding (Russell et al., 1993). Just as the study of information foraging behavior has led to techniques for designing more fluid search experiences, so can an appreciation of how people make sense of information help us design tools that facilitate comprehension, analysis, and insight.

Human memory

Humans are able to remember many different types of information—from how to ride a bicycle (procedural) to the teachings of classical Greek philosophers (semantic) and the fireworks of last New Year's Eve (episodic). Most relevant for our purpose, however, is long-term *semantic* memory, which is responsible for keeping track of our ever-growing conceptual knowledge (Tulving, 1985). Semantic memory organizes knowledge into a schema of interconnected nodes that our minds can manipulate and explore at will (Miller, 1987), a simplistic visualization of which can be represented by mind map diagrams such as the one in Figure 2.10.

This internal semantic schema is constantly in flux. New information may require our semantic memory to add new nodes to the existing schema, reorganize the links between nodes, or discard concepts that are no longer pertinent. This is the realm of sensemaking: growing, rearranging, and pruning the semantic tree of knowledge.

Four stages of the sensemaking process

Sensemaking explains how information seekers go about foraging for information, extracting relevant concepts, and encoding that information into semantic memory while gaining insights along the way (Pirolli and Card, 2005). There are four stages to this process: the first two overlap with information foraging, and the second two are unique to sensemaking. We'll consider the process from the perspective of a patent analyst.

Simon Carter works on a team of patent analysts at a large corporation. When a business unit thinks of a new product, they ask Simon's team to find out whether other companies have similar products and whether the company should seek a patent of their own. His latest assignment is to determine whether the company's new solar cell manufacturing technique could legally justify a patent.

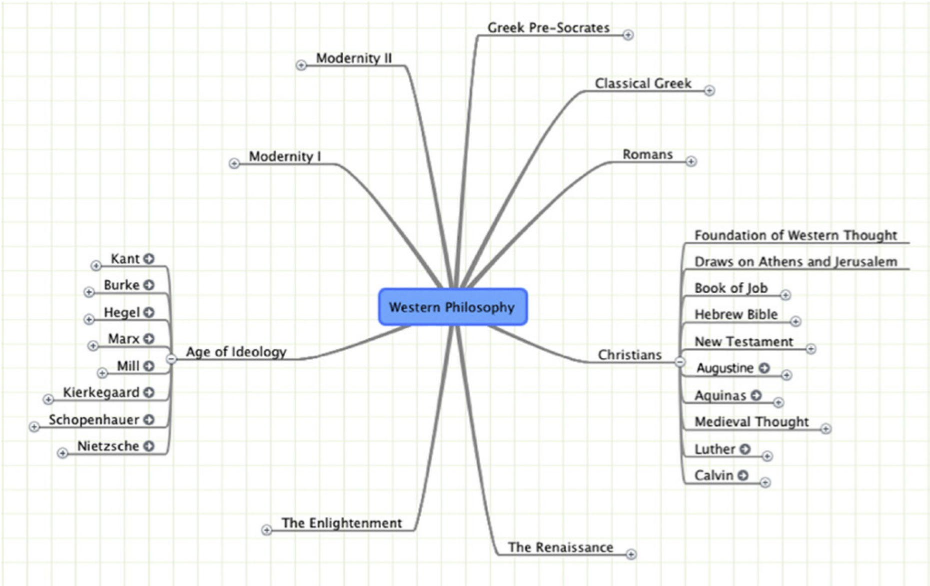

FIGURE 2.10 This mind map created on MindMeister.com visualizes one person's understanding of western philosophy.

1. Search
   The first step toward sensemaking is to locate documents that may be meaningful for the investigation. Simon pulls up his trusted sources—the U.S. Patent Office, specialized patent databases, Google—and casts a wide net for anything and everything that might pertain to solar cell design and manufacturing.
2. Extract
   Once potential documents have been identified, meaningful information must be extracted from them. Simon quickly scans each page and, where there is strong information scent, pauses to inspect the content more closely.
3. Encode
   The extracted ideas must then be integrated into Simon's semantic memory. His schema of the domain is constructed of entities such as products, companies, and manufacturing techniques. The more he researches, the more detail is added to the schema.
4. Analyze
   As knowledge increases, the schema itself can be analyzed to gain insights. These insights prompt Simon to test new hypotheses against his knowledge, potentially reinterpreting the extracted information.

From internal to external schemas

Thus far, we've treated the semantic schema as the internal model of an individual's knowledge. However, the finite capacity of the human mind ensures that one's own understanding is only a subset of reality. In the same way that a map is a compact representation of a much larger landscape, so our internal semantic schema is a simplified sketch of a much broader body of knowledge. Computer scientist Jay Wright Forrester described this discrepancy between the real world and our internal models of it (Forrester, 1971):

> The mental image of the world around you… is a model. One does not have a city or a government or a country in his head. He has only selected concepts and relationships which he uses to represent the real system. (p. 54)

Sophisticated information tasks demand that one's *internal* semantic model be disseminated into an *external* schema. External schemas can not only store a greater amount of information than an internal schema, but can also serve as a conduit for collaboration.

Designing for sensemaking

Patent researchers, intelligence analysts, academic researchers, and other knowledge workers must often make sense of in-depth information landscapes for which internal memory will not suffice. Although external memory aids can be as simple as a sketch on the back of a napkin or a wall of sticky notes, digital tools can help users construct and browse external schemas that often lead to insights that might have otherwise been missed.

Pirolli and Card (2005) observed three common practices used by intelligence analysts to conduct large-scale sensemaking, which they term the shoebox, the evidence file, and the schema.

The shoebox

The first step in many investigations is to gather potentially relevant documents into a single collection—what could be coined the *shoebox* (a term that recollects putting something away for later). At this stage, the analyst isn't concerned with a close examination of each document; the top priority is to populate the shoebox as quickly as possible with anything that might be relevant to the investigation. The analyst heavily relies on information scent to make rapid judgments about which documents should and should not be included. To support this behavior, the user interface should enable the analyst to add documents to the shoebox as rapidly as possible. For instance a text link, checkbox, or icon (Figure 2.11) could be provided for quickly saving a given search result.

The evidence file

Once the shoebox has been populated with potentially relevant documents, the analyst often then begins a more thorough examination of the curated collection. This time around, the analyst spends significantly more time scrutinizing the text and images when looking for possible leads. When the analyst spots a striking sentence or meaningful image, he or she extracts that snippet and saves it to a more cogent collection of relevant information: the evidence file.

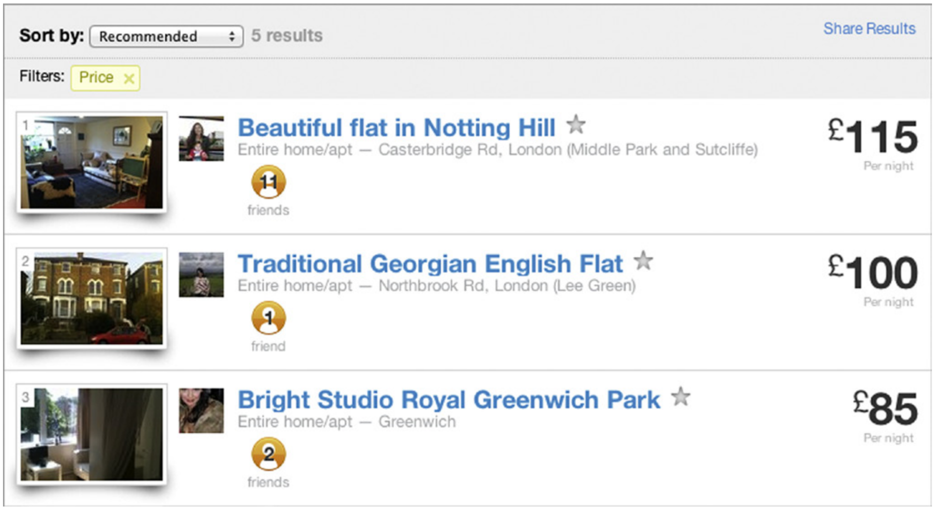

FIGURE 2.11 Airbnb.com places a star icon next to each search result. Clicking on the star saves that result to the user's "favorites list."

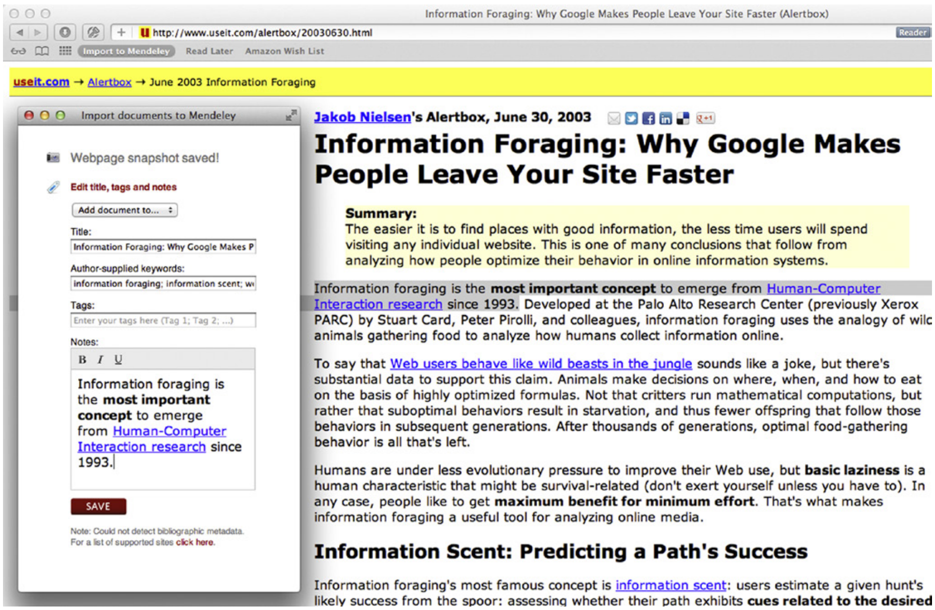

FIGURE 2.12 Mendeley's document import tool.

A simple example of an evidence file is Mendeley, a tool that helps academics manage their research. Mendeley provides a special bookmark that users can add to their web browsers (Figure 2.12). When clicked, a popup window appears and prompts the user to save a title, keywords, tags, and meaningful notes extracted from the current

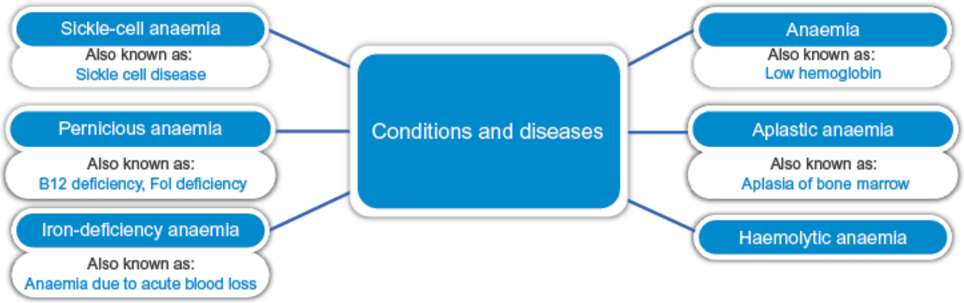

FIGURE 2.13 The "conditions and diseases" node of a much larger external semantic schema on the NHS Evidence website.

page. The shoebox is the outcome of a net widely cast; the evidence file is the product of a fine sieve.

The schema

The external schema provides an even bigger picture of how the extracted evidence fits together. It may be constructed of the people, places, and events surrounding a crime or the causes and symptoms of a disease (Figure 2.13). Also known as an *ontology*—a specification of a shared conceptualization—the external schema enables analysts to continually explore, gain insights from, and test hypotheses against the model as it is constructed.

It's through sensemaking that the information seeker iteratively refines his or her understanding by either updating his or her internal semantic memory or contributing to an external schema. Together, information foraging and sensemaking guide us to and enable us to understand the nuggets of information that satisfy our information need.

STAGES OF INFORMATION SEEKING

As you may recall, the first models of information seeking that we discussed at the beginning of the chapter considered the user's information need to be unchanging, while later models acknowledged its evolving, dynamic nature. Information foraging and sensemaking have also demonstrated that users must sometimes deal with complex tasks that push the limits of human memory. In fact, far from being isolated to a single, self-contained search session, information seeking can be a long-term endeavor made up of not just one, but a multitude of information needs. To understand this macroscopic perspective, we must turn our attention to the stages of information seeking.

The six-stage funnel

Users often engage in episodes of information seeking spread over days, weeks, and even months as they strive to accomplish tasks such as finding a place to live, buying a car, or booking a vacation. But episodes aren't static; in fact, users progress through a series of

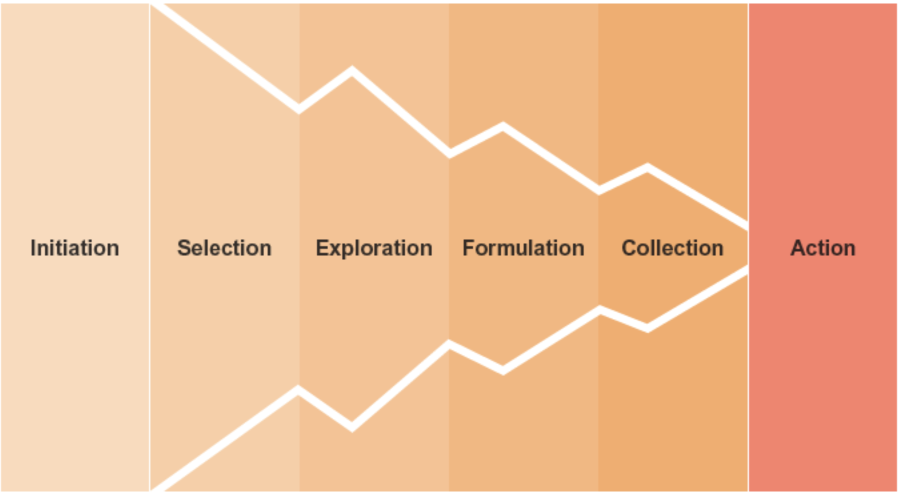

FIGURE 2.14 Kuhlthau's six stages of information seeking can be represented as a funnel that begins open-ended and ends with a resolution.

stages during the lifecycle of a given work task (we'll look at work tasks in more detail in the next chapter). These stages funnel the user's journey from clouded beginnings to a decisive conclusion.

Carol Kuhlthau, a professor at Rutgers University, performed a series of studies during the 1980s to better understand how people seek information to satisfy long-term goals (Kuhlthau, 1991). Her studies included high school and college students who were performing research for a term paper and adults with personal or job-related projects. Kuhlthau identified distinct phases in what she called the *information search process* but is best described as stages of information seeking (Figure 2.14). She observed both the tasks and emotions unique to each of six phases:

1. Initiation
   Initiation is the phase in which one becomes aware of a need for information, an event often accompanied by uncertainty and apprehension. For instance, lets imagine that Fane Tomescu recently decided that he wanted to buy a car, prompting a need to research suitable vehicles.

2. Selection
   The selection phase involves committing to constraints that narrow the information search. Fane quickly eliminated motorcycles, vans, and SUVs, deciding to look only at small family cars. Kuhlthau found that this phase tends to produce a spike in optimism once the user makes the selection.

3. Exploration
   The optimism of selection usually gives way once more to confusion, uncertainty, and doubt as one realizes the many options still left to explore. Even though he had

decided on small family cars, Fane still had to sift through dozens of makes and models, each of which had advantages and disadvantages. In Kuhlthau's study, about half of her students never made it past this stage.

4. Formulation
   Formulation is the crucial turning point at which all the information encountered thus far is formulated into a specific, tangible requirement. Fane's car hunt reached the formulation stage when he decided that a four- to six-year-old VW Golf hatchback with 30,000 to 50,000 miles was the best fit for his needs and budget. The formulation stage is characterized by decreased anxiety and increased confidence.

5. Collection
   Once the problem has been clearly articulated in the formulation phase, the next step is to evaluate the available solutions. Once Fane had a clear idea of the model he wanted, he used automotive websites to search for cars in his area that matched his criteria. Confidence continues to increase throughout the collection process.

6. Action
   The final stage of the process is to act on the newly acquired knowledge. For Kuhlthau's students, this meant writing the term paper. For Fane, it meant going to look at a car, transferring money, and driving the car home.

Designing for the journey

Kuhlthau's study demonstrates that users engage in very different tasks during each stage of the information seeking process. Most search applications, however, invest most of their effort into streamlining only the narrow end of the funnel: the collection and action phases. It's understandable—businesses make money through conversions. However, the company that best supports the user throughout the entire process has the advantage in converting that loyal user into a paying customer or dedicated subscriber. There are a number of methods for assisting the users through this journey, from facilitating exploration and helping organize their findings to enabling them to monitor for changes.

Open-ended exploration

Uncertainty characterizes the initial phases of the information seeking process. Whether the task is looking for a place to live, finding the perfect car, or planning a vacation, it's unlikely that the user knows exactly which house is best, what car is ideal, or precisely where to go on holiday at the outset. Yet these are often the first questions that real estate, automotive, and travel sites ask us (Figure 2.15).

In order to engage users earlier in their journey, we must help them explore (Marchionini, 2006). Flexible filtering controls can facilitate browsing without the need for an initial query, helping the user survey the information landscape and potentially make serendipitous discoveries along the way. Although automotive sites AutoTrader and Motors.co.uk both allow users to choose specific makes and models, the latter (Figure 2.16) also caters to those who haven't yet formulated an exact specification, allowing them to filter by body style, color, number of doors, number of seats, and many other factors.

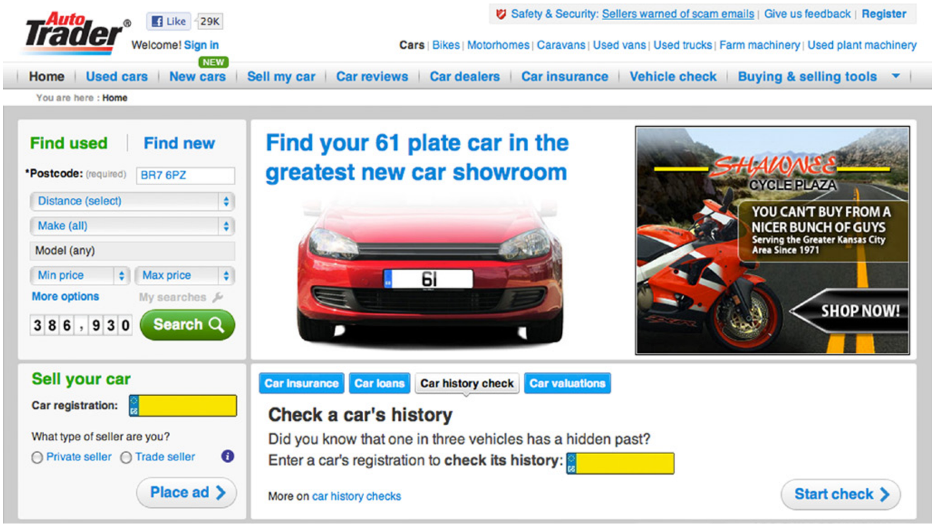

FIGURE 2.15 Autotrader.co.uk asks the user to specify an exact make and model of car up front.

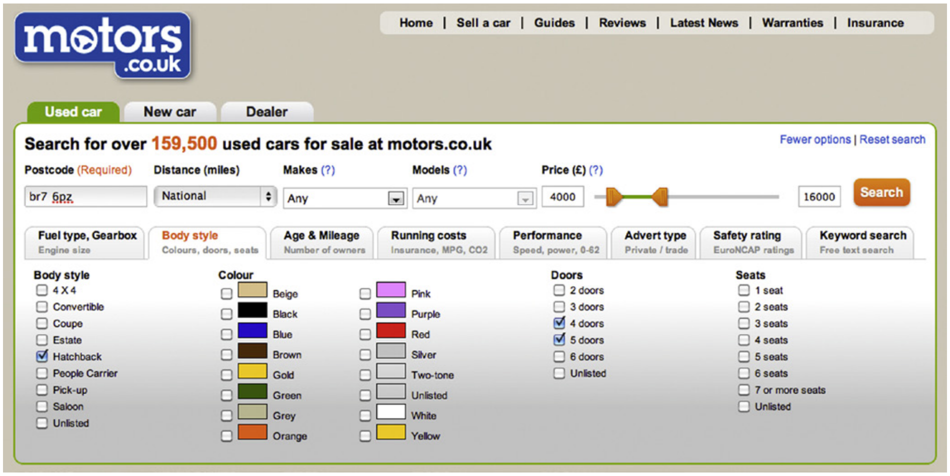

FIGURE 2.16 Motors.co.uk provides flexible filtering options, making it easy for users to look for cars even before deciding on a particular make and model.

Information management

Although users may want to explore early in the process, they must also keep track of what they encounter along the way. As we've seen, the human mind is constantly sensemaking, and we often appreciate tools that augment our memory. Equipping users to bookmark, categorize, and annotate findings can greatly streamline the long-term information seeking process.

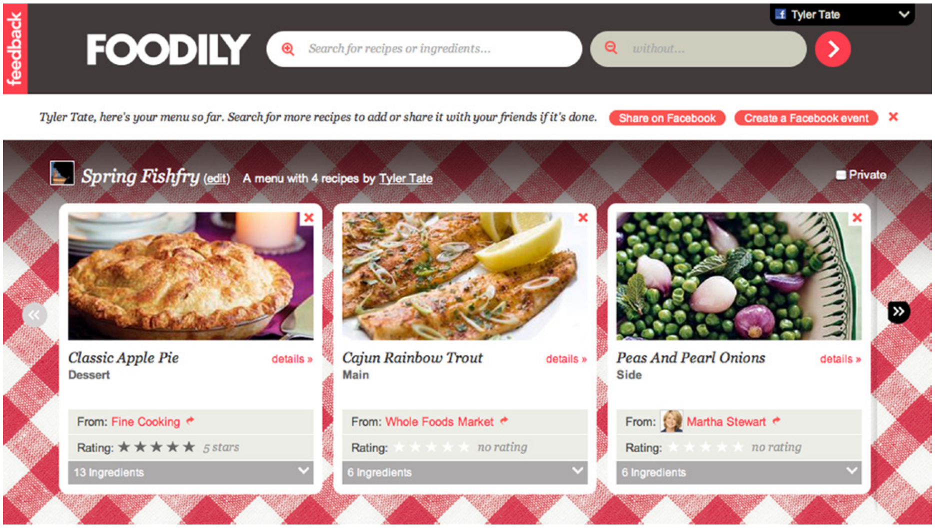

FIGURE 2.17 Foodily, a recipe search engine, allows users to save their favorite recipes and organize them into meal plans.

Bookmarking can help users refind items of interest at a later date. What's more, grouping bookmarks into meaningful sets—like placing recipes into "meal plans" on Foodily (Figure 2.17)—can help users organize large collections of information. Ratings and annotations—such as the personal notes and one- to five-star rankings that can be added to saved properties on Globrix (Figure 2.18)—can further extend the user's memory by making it easier to compare and differentiate saved items.

Monitoring

Toward the end of the information seeking funnel—once the user's exact need has crystallized but before an ideal match has been found—the need to monitor for new opportunities sometimes arises. After searching for VW Golfs in his area, for instance, Fame Tomescu might not have been satisfied with the cars on offer. He may have chosen to patiently repeat the same searches on the same websites day after day, diligently waiting for that perfect deal to show up.

Applications can facilitate monitoring in two ways: on demand or automatically. Enabling the user to save a search query along with any applied filters provides a means for returning to that query *on demand* at a later date. Often, however, users may prefer to be *automatically* notified by email when a new match to their criteria appears, reducing the need to continually check back (eBay, pictured in Figure 2.19, provides both).

Empowering users to freely explore, easily organize their findings, and monitor for new information are just three techniques for assisting the user throughout all the stages of information seeking. The expectations of users are growing, and it's in the best interest of businesses to engage the user at every stage of the process, from initiation to action.

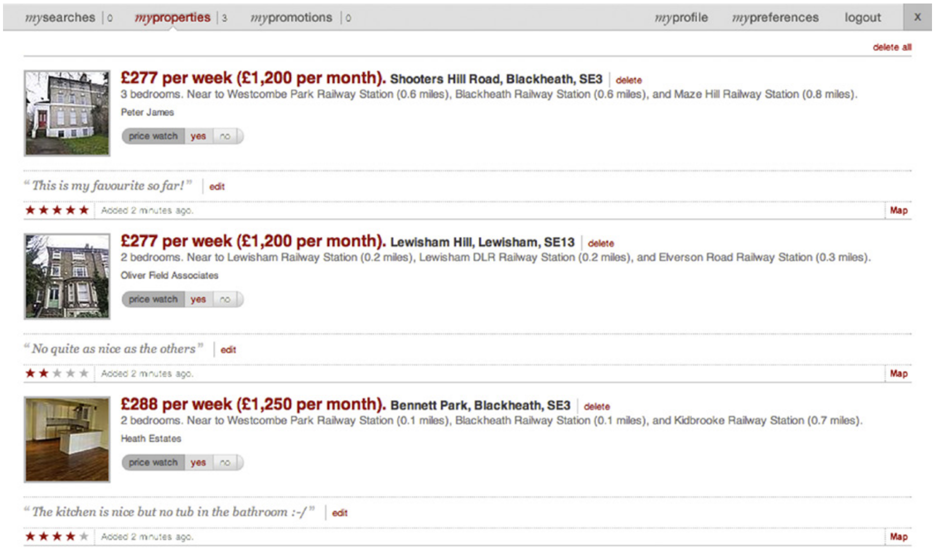

FIGURE 2.18 Property search site Globrix allows users to assign a rating and write notes on each property that they've bookmarked.

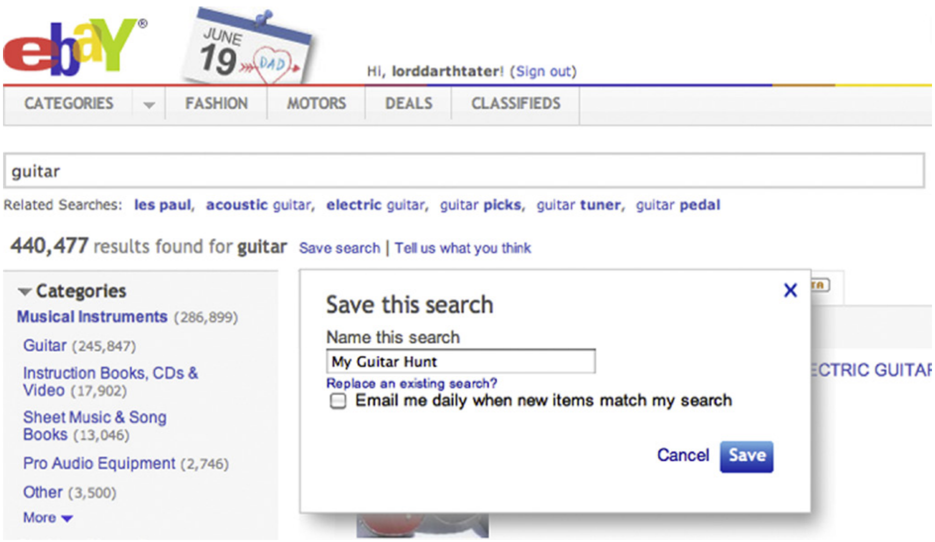

FIGURE 2.19 eBay allows users to save searches and, by checking a box, to be notified by email when new items are added.

SUMMARY

Information seeking is, as we described it at the beginning of the chapter, the journey between the surfacing of an information need and its fulfillment. But it is also an iterative, dynamic activity in which what we find changes what we seek; it is a long-term process spread across distinct stages, each with unique tasks and corresponding emotions. Information foraging keeps the journey moving in the right direction; sensemaking helps us understand what we find along the way.

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Information Encountering and Serendipity

Ann Blandford

Most information resources support people searching for information. But people also often encounter information without explicitly looking for it. Information encountering also shifts people's understanding in subtle ways, and these shifts may also be designed. For example, museums and galleries can be designed to support meaning making (Silverman, 1995): through the ways that objects are organized and presented, through the accompanying information, and through the provision of digital tools that allow visitors to negotiate their own understandings of how to interpret artifacts (e.g., Laurillau & Paternò, 2004).

In other contexts, as more information becomes available any time, anywhere, it is harder to design explicitly for particular kinds of information experience. One valued feature of traditional libraries was their support for serendipity: visitors would often come across valuable information that they were not expecting, due to the layout of the collection and the fact that people had to walk past other stacks to reach their intended volume. How to recreate this sense of chance encounters in the digital space, where the quality of search engines is such that people are often taken "straight there" in response to their queries? There has been some work designing technologies (e.g., Toms and McKay-Peet, 2009) to introduce people to new information resources that are relevant to them in their current situation, and there is a growing interest in engineering for serendipity. In our own work, we have gathered lots of serendipity stories. From these, we have developed a framework that starts with events leading up to making a new connection that is unexpected and requires insight (Makri and Blandford, in press). To be recognized as serendipity, the individual has to exploit the unexpected connection and recognize the value of the outcome, which poses a challenge: how do you design for something that depends on chance and insight? We are choosing to focus on nonobvious connections: introducing people to nonobvious literature or to people who have complementary interests, which recognizes the importance of both information resources and other people in the information ecology.

In many situations, people's understanding can evolve in spite of, rather than because of, the ways systems and processes are designed. For example, Brown and Duguid (2000) describe a study of photocopier work, in which the engineers are employed to work individually most of the time but actually meet up regularly (often in their own time) to exchange stories and tips. Brown and Duguid describe the evolving understanding of each engineer as being like the "passage of the sun across the sky" (p. 103): often there are no huge conceptual shifts, but there are imperceptible changes in understanding that become apparent only some time later. Information is encountered through informal chats, to be used when relevant at a later date.

This finding brings into stark relief a challenge that faces all organizations: how to keep people aware of developments and new possibilities. There are of course many facets to this problem, but one is maintaining people's awareness of events and other news in an organization. Adams and colleagues (2005) report on the development of an awareness server that was intended to be used by all groups across an organization (in this case, a hospital). The awareness server was a screensaver that was activated when a computer had been idle for a short period. The initial motivation for developing it had been to ensure that sensitive personal information was hidden from passersby; however, over time, it became valued as an information resource in its own right. Adams and colleagues (2005) identified two key reasons for its success: first, that a participatory design approach had been taken, so that many stakeholders across the organization had input into the design, including the kinds of information that were displayed on the awareness server; and second, that the awareness information was unintrusive but typically available at times when people were working less intensely (e.g., engaged in discussion or having a tea break).

There are many ways of designing resources that allow people to encounter information without actively seeking it, such as designing for meaning making, serendipity, and awareness. Probably the greatest challenge, though, is designing to maximize the value of information encountering while minimizing the sense of information overload.

Ann Blandford is Professor of Human–Computer Interaction at University College London and former Director of UCL Interaction Centre. Her first degree is in Maths (from Cambridge); her PhD is in Artificial Intelligence (from the Open University). She started her career in industry as a software engineer but soon moved into academia, where she developed a focus on the use and usability of computer systems. She leads research on how people interact with and make sense of information and how technology can better support people's information needs, with a focus on situated interactions. She has more than 200 international, peer-reviewed publications, including a Synthesis Lecture on "Interacting with Information."

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