3

The Concept of Information

> Information seems to be everywhere. We talk of its being encoded in the genes … disseminated by media of communication … exchanged in conversation … contained in all sorts of things … Libraries are overflowing with it, institutions are bogged down by it, and people are overloaded with it … [yet] no one seems to know exactly what information is.
>
> Christopher Fox (1983, p. 3)

> Information, usually seen as the precondition of debate, is better understood as its by-product. When we get into arguments that focus and engage our attention, we become avid seekers of relevant information. Otherwise we take in information passively — if we take it in at all.
>
> Christopher Lasch (1995, p. 162)

Chapter Outline

3.1 Searching for a Definition of Information

"Information" is a fairly old English word, making an early appearance in one of Chaucer's tales sometime between 1372 and 1386 (Schement, 1993a, p. 177); Capurro and Hjørland (2002) take its orgins back to Latin and Greek terms of the pre-Christian era. One would think that hundreds of years of usage would tend to settle a word and result in a consensus on its meaning. This has not been the case with the term "information." Especially in the last five decades, as the various phenomena that people call information began to be objects of empirical study, meanings of the word have proliferated. Schrader (1983, p. 99) goes so far as to complain about "the multiplicity of vague, contradictory, and sometimes bizarre notions of the nature of the term 'information'."

One of the problems of studying any phenomenon — or merely talking about a thing — is reaching an agreement on what to call it. Words are ambiguous, the same string of characters often having multiple meanings. Each meaning may identify a distinct concept, in the way that the noun "port" can refer to a fortified wine, the left side of a ship, or a gateway or opening for passage (a harbor, a modem port, a valve port, etc.). The case of the word "information" is much more complex, as it has been used to denote various *overlapping* concepts, rather than neatly distinct phenomena as is the situation with "port."

Unless otherwise stipulated, in this book "information" will be taken to mean *any difference that makes a difference* to a conscious, human mind (Bateson, 1972, p. 453). In other words, information is whatever appears significant to a human being, whether originating from an external environment or a (psychologically) internal world. This definition was chosen by the anthropologist Gregory Bateson, after he had struggled for two decades with the inadequacies of mathematical definitions of information. A *perceived difference*, according to Bateson, is a basic "unit of mind" that can be inferred through study of both humans and animals.

Other authors have employed definitions of information that are similar to Bateson's. A popular version originated with psychologist George A. Miller (1968): information is *any stimuli we recognize in our environment*. Others (e.g., Dervin, 1976a; Farace, Monge, & Russell, 1977; Higgins, 1999; Johnson, 1997; Rogers, 1986) have generalized such statements to mean the *recognition of patterns in the world around us*.

Obviously, the characterization of information as a difference implies a very broad definition for a common word that has been defined in several distinct ways — with virtually all other definitions implying more restrictions on meaning. That is, many authors have used other words to define a concept that they have called "information," some of them incorporating specific requirements, such as information must always be *true* or *useful*, or it must be *embodied* in a form or object, or it must be *intentionally* transmitted, and so forth.

The reason for adopting this broad (some would say vague) definition is because this book reviews a great many studies from several disciplines and needs to cover a variety of more restrictive concepts. The reason some other definitions are less appropriate will be made clearer in the remainder of this chapter, which first discusses the nature of conceptual explication, and then examines a variety of definitions for "information," each of which identifies a somewhat different concept than the rest.

3.1.1 Explicating "Information"

To discuss and study any concept, we first need to define it. In the process, we may identify and define other ideas that are related to (and sometimes derived from) the concept under study. In the case of information, related concepts are "knowledge" and "data." "Information behavior," "information seeking," "information source," and "information use" are among several higher-order concepts that build upon the concept of information.

Social scientists call the process of defining a concept *explication*. As discussed by Steven Chaffee (1991), explication is the intellectual process that relates theory to research, that links a focal concept to the ways in which it is studied. For researchers who aspire to direct observation of phenomena, explication eventually results in an *operational definition* of a concept, a set of procedures used to observe and measure instances of a concept. In this chapter, we will deal only with the initial stages of explication — reviewing and analyzing existing definitions — and leave issues of measurement for later chapters.

The process of explication often starts with a word for which we have only a general meaning. At this stage we have only a nominal, or dictionary, definition for a term — that is, a word is defined by other words. Explication continues by examining what has been written about the concept; we review the publications about it, with an eye toward how different authors have defined and used the concept. In doing this we may not only find multiple definitions for the term, but discover that some authors have studied the same concept but called it by a different name.

The next step in explication is to *analyze the meaning* of a term by one or both of two approaches. The first possible approach is a top-down procedure. We *distill* the discussions of many authors to their abstract core: what is the heart of what they say about the concept? In the case of information, a core idea may be that it is a message expressed in some medium, and/or that it has the potential of altering a person's consciousness. As Chaffee points out (1991, pp. 26–27), finding a single, central meaning is unusual, particularly when distinct research literatures are examined.

In the second alternative, the bottom-up approach to meaning analysis, we *list* all of the subsidiary concepts that make up the focal concept. For "information,"

we might attempt to list exhaustively all of the possible forms that information could take — a Web page, a book, a radio broadcast, a conversation, a handwritten note, e-mail, and so on. This is a massive task that would be subject to change over time as new forms of information appear or are identified. Listing all examples of information has been one way that researchers have guided the *observation* of the concept.

Whichever means of analysis is chosen, the eventual result is a more abstract definition than one defined by near synonyms. The definition may be expressed as a series of critical distinctions between the focal concept and related concepts; for example, what is the difference between information and data? Or, instead, it may simply identify attributes that serve to identify something as an instance of the concept; for example, a book is an instance of information because it contains symbols that can, or are intended to, inform someone.

The remainder of this chapter will consider, through literature review and distillation, the various definitions of information and their key distinctions.

3.1.2 The Concept of Information

Ordinarily, we both use and hear the word "information" without much concern for its definition; *we* know what we mean when we use the word. At first glance, the *Oxford English Dictionary* definition seems adequate: "(1) the action of informing. The action of telling or fact of being told of something. (2) That of which one is apprised or told; intelligence, news." This nominal definition reveals at least one important distinction: the term may be used to indicate either a *process* (informing) or a kind of *message* (news).

Further distinctions lay buried in the nominal definition, as a series of publications have made obvious. One explication of the term (Wellisch, 1972) uncovered eight distinct definitions of information, without any common elements. Not long afterward, Wersig and Neveling (1975) identified 17 unique definitions, which they grouped into six broad categories. Summarizing 30 years of commentary, Levitan (1980) declared that 29 different concepts had been associated with the term information. A review by Schement (1993b) includes a selection of 22 definitions written between 1968 and 1989. How has the concept of information been used such that so many definitions have resulted?

The central difficulty is that the word "information" has been used to denote several different concepts. The adoption of the term by multiple disciplines is part, but not all, of the problem. The same term has been used to refer to, among other phenomena, sensory stimuli, mental representations, problem solving, decision making, an aspect of human thinking and learning, states of mind, the process of communication, judgments about the relevance

of information to information needs, the content of subject specialties, recorded knowledge, and particular objects that carry information such as documents. It is no surprise that scholars have struggled to come up with a formulation that promises to condense most of these meanings into one universal principle or attribute.

3.1.3 Typologies of Information Concepts

Let's first examine four parallel attempts to identify different "families" of information definitions. Two attempts to distinguish types of information concepts, one from 1976 and the other from 1992, illustrate how periodically we revisit the problem of defining information. Two articles by Brenda Dervin (1976a, 1977) set the stage for the development of the *sense making* school of thought (see Chapters 4 and 7) regarding information seeking. In her articles, Dervin posited three types of information, based on the writings of philosopher Karl Popper (1972):

1. *Objective*, *external* information is that which describes reality (but never completely so).
2. *Subjective*, *internal* information represents our picture or cognitive map of reality, the structures we impute onto reality.
3. *Sense-making* information reflects the procedures and behaviors that allow us to "move" between external and internal information to understand the world, and usually to act on that understanding as well.

Dervin argues that to look at information in such a way has several advantages. For example, it acknowledges that legitimate inputs may come from inside us, rather than viewing the only important information as arising from external sources. In a similar way, this view does not privilege formal information systems (e.g., books) over informal sources (e.g., friends, relatives, or coworkers); consulting the latter is a much more common approach to understanding than are the former channels.

In a manner reminiscent of Dervin, Brent Ruben (1992, pp. 22–24) places information conceptualizations into three "orders." The first of these captures information as "environmental artifacts and representations; environmental data, stimuli, messages, or cues." This *environmental* (Ie) sense of information consists of "stimuli, messages, or cues, waiting to be attended to." Second-order information is that which is "internalized, individualized appropriations and representations." Here Ruben identifies information as something that is "transformed and configured for use by a living system," *internal* (Ii) representations that include "semantic networks, personal constructs, images, rules or mind." And the third type of information is that which is "socially constructed, negotiated, validated,

sanctioned and/or privileged appropriations, representations, and artifacts." Third-order information, then, is the *social* (Is) context of information.

Dervin's and Ruben's types are parallel but not identical, especially in the terms and examples they use to describe their third category, which for Dervin is decidedly intrapersonal, abstract, and process oriented. For Ruben, the social context is external, is socially constructed, and may encompass physical objects like books (which seem to fall under Dervin's objective category).

Two other typologies, both from the 1990s, are also somewhat parallel, but they bear only a modest resemblance to the Dervin and Ruben schemes. Michael Buckland's (1991a) widely cited typology portrays uses of the term "information" as falling into three categories. The first category is *information-as-process*, which refers to the act of informing, the communication of information, and how a person's state of knowledge is changed. A second sense of information is *information-as-knowledge*, a usage of the term denoting that which is perceived in the first category (i.e., the knowledge communicated). The final sense of the term is *information-as-thing*, in which "objects, such as data and documents … are referred to as 'information' because they are regarded as being informative."

Buckland takes great pains to explain the difficulties inherent in such a typology, pointing out the intangible nature of the first two categories (which makes them difficult to observe), the issue of intentionality (some definitions of information take for granted an intention to communicate), and the problem that any object in the world might potentially be informative ("if everything is information, then being information is nothing special"). He concludes that it is essential to investigate information-as-process, even though information-as-thing cannot be dismissed as a focus of study.

The second typology is similar to that of Buckland but breaks out his two categories of information-as-thing and information-as-knowledge into three overlapping conceptions of information. Altogether, McCreadie and Rice (1999, pp. 47–58) identify four distinct "conceptualizations," the first of which is information as a *resource or commodity*. Under this conceptualization, information is something that can be "produced, purchased, replicated, distributed, sold, manipulated, passed along, controlled" — such as a message that travels from sender to receiver, with or without some kind of payment in exchange.

The second type of information is characterized as data in the *environment*, that is, "objects, artifacts, sounds, smells, events" that may be perceived in the environment. This category takes into account the potential for unintentional communication of information, such as when one observes and interprets natural phenomena.

McCreadie and Rice's third type of information concept is that expressed as a *representation* of knowledge, such as that expressed in "documents, books, periodicals." Finally, their fourth type of information is as a part of the

communication process. That is, information is meanings that are created as people go about their lives and try to make sense of their world.

While at first glance it may seem that these latter two typologies characterize types of information in similar ways, there are several differences, particularly in the distinctions they make between *representation*, *thing*, and (in the case of McCreadie and Rice) *resource*. McCreadie and Rice use "documents, books, periodicals" among their examples of representations, whereas Buckland uses those as examples of "things." It seems that McCreadie and Rice are trying to make finer distinctions than Buckland regarding possible embodiments of information.

Ultimately, the typologies of Dervin, Ruben, Buckland, and McCreadie and Rice are each distinct from one another in several ways. At least the distinctions these authors make are useful in illustrating the many ways one could parse the attributes of the information concept.

3.2 Definitions of Information and Their Problems

The typologies discussed above fall short of providing specific definitions of "information." Rather, their intention is to show that there are distinct usages of the term rather than a single universal usage.

Nevertheless, many authors have attempted to create a general definition of information that at least would be adequate for some areas of investigation. As we shall see, many scholars have incorporated into their definitions specific and powerful assumptions regarding the nature of information.

We will begin our examination with the most influential definition of information, one that developed a half-century ago for the study of signal transmission in broadcasting and telephony. Now it might seem odd that a definition for such a mundane concept as information should come to us from a highly specialized field as telephone engineering. In fact one writer (Tor Nørretranders, 1991; English translation 1998) jokes that

> there are plenty of grounds for a conspiracy theory of the most devious kind: that the notion of information was invented and developed by engineers from big private corporations who then made a profitable business out of having the rest of us talk about truth, beauty, meaning and wisdom — on the phone. (p. 96)

In Nørretranders's view, this development was unfortunate because it shifted our attention away from the more important elements involved in information — the senders and receivers of messages — and toward characteristics of the carrier.

3.2.1 The Influential and Restrictive "Information Theory"

The first widely recognized attempt to define information, the misnamed "Information Theory" (properly called "The Mathematical Theory of Communication") is still frequently invoked to describe the nature of information. The popularity of information theory cannot be overemphasized: a review of two decades past (Zunde, 1984) listed over 400 selected citations to this theory; by now, the number of references to information theory surely runs into the thousands.

Fifty years ago, the works of Claude Shannon and Warren Weaver (1949) on communication of messages gave rise to a popular conception of information. Shannon, an engineer at Bell Labs, was concerned with the fidelity of telecommunications signals, such as those sent over radio waves, and the determination of the effective capacities of telecommunication channels. It was Shannon who came up with a model of communication as a process of signal transmission. His became the basis for applying measures to parts of messages based on the statistical probability of their appearance — a technique that led to improvements in signal transmission because it helped to predict the likelihood of errors and decide how to correct them, such as the sending of redundant portions of a message.

In Shannon's famous diagram (Figure 3.1), the *source* and *destination* of a message were seen as being at the opposite ends of a chain, linked by a *message* converted by a *transmitter* into a *signal* sent over some kind of *channel* to the *receiver*, which converts the signal back to a message for delivery to the *destination*. The channel was acted on by sources of *noise*, which could disrupt or distort the message.

Along with the diagram came both a definition and measure for the concept of information, as it is encoded in a message. Shannon's definition of information was based on the notion of *entropy*, a measure of the degree of disorganization in a system which reflected a tendency for any state of affairs to lose order and become more random. In signal transmission, *noise* is the vehicle for the effects of entropy, that is, noise degrades the signal to some degree. Messages are organized exchanges (e.g., grammatical sentences) based on *selections* from an agreed-upon set of signals (phonemes, words, letters, etc.). The requirement that the message elements are selected from a fixed universe of

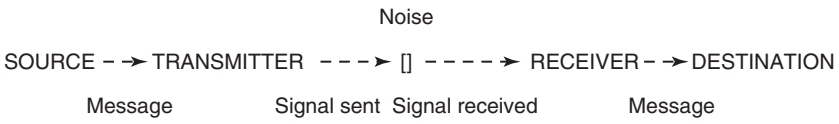

Figure 3.1
Shannon's model.

possible elements has led some scholars to refer to it as a theory of "*selective* information," to contrast it with theories of "*semantic* information," that is, theories concerned with the *meaning* of messages.

The effects of entropy lead to more randomness in messages that, in turn, leads to higher levels of uncertainty. In Shannon's view, these *higher levels of uncertainty imply the potential for more information* in the message. At the opposite end of the entropy scale would be messages that are highly organized — and thus familiar to the receiver, but which tend to carry little "new" information. Shannon's *theorems* dealt with statistical probabilities associated with the selection of signals from a well-defined set. However, subsequent applications of Shannon's work tended to interpret the theory in terms of uncertainty reduction for the receiver of the signals — what Ritchie (2003) calls "epistemological probability."

Such a definition of information is somewhat counterintuitive because we tend to associate information with certainty, rather than uncertainty (Miller, 1983a). In fact, Shannon had been advised by computer scientist John von Neuman to call his concept "entropy" rather than "information" (or "uncertainty," another near synonym) because entropy was a vague term less likely to be confused with the vague, everyday meanings associated with the word "information" (Campbell, 1982, p. 32; Machlup & Mansfield, 1983, p. 48). Indeed, these opposite or "negative" forms of Shannon's definition appeared in the writings of physicist Leo Szilard in 1929 and philosopher Charles Pierce in 1878 (Morowitz, 1991).

To demonstrate how easy it is to misunderstand Shannon's notion of uncertainty when we apply it to human communication, Miller (1983a, p. 495) provides the example of the sentences "Rex is a dog" and "Rex is a mammal." The latter sentence contains terms less likely to appear in everyday usage, so according to Shannon's measure it would carry more "information" that is, a rarer, more surprising, message. But the term "dog" is *more specific* than "mammal" (which could be a dog, a bat, a dolphin, or many other creatures); semantically, therefore, we would judge that "Rex is a dog" carries more information, reversing the logic of Shannon's measure. It is all too easy to misinterpret Shannon's definition of information outside the realm of signal transmission (Losee, 1997).

Common misunderstandings of Shannon's Information Theory are partly attributable to his coauthors and advocates. Warren Weaver, a physicist, was invited to write an introduction to two journal articles by Shannon that the University of Illinois was publishing under the title *The Mathematical Theory of Communication*. In his introduction to Shannon's work, Weaver speculated on how Shannon's model of signal transmission might be applied to *human* communication. Weaver acknowledged in a later publication that the model could be taken too literally: "*Information* must not be confused with *meaning*," Weaver said (1949, p. 8). Thus, he anticipated that some scholars would attempt to extend the theory to the subjective interpretation of signals by humans.

Nevertheless, Weaver's broad-ranging analogies and speculations became conflated with the very limited theorems devised by Shannon, much to the latter's chagrin; according to Ritchie (1986, 1991), it is Weaver's extrapolation of Shannon's model to which most writings refer, not to Shannon's original explanation and theorems. To confuse matters further, Shannon himself was inconsistent in his use of the terms uncertainty and entropy (Cole, 1993).

Despite its flaws, Shannon's simple depiction of *signal transmission* as linear, one-way process was seen by many scholars as an adequate model of human communication. Additional interpretations (e.g., Berlo, 1960) resulted in inevitable simplification and distortion of the model. David Berlo's famous "Source-Message-Channel-Receiver" model (Rogers, 1986, pp. 86–90) dropped the "signal" component of Shannon's model. Conflating the concepts of message and signal ignored an important distinction between meanings (messages) and their encodings (signals).

For several decades, various simplified versions of Shannon's model became the basis for studying the exchange of messages among people (Rogers, 1994). As Jesse Shera and Donald Cleveland (1977) put it,

> Everybody tried to get into the act, hopeful that Shannon's magical formula would unlock countless information secrets and give a quantitative measure for laying a scientific theoretical foundation for practically every major field lacking one. Unfortunately this overextension was generally an intellectual get-rich-quick scheme and, in the long run, most of the hopefuls fell to the wayside. (p. 261)

A 1974 article by James Watt and Robert Krull can serve as an example of how some researchers applied Shannon's concepts. In a study of television viewing habits, Watt and Krull noted that other researchers had no classification system in common for program contents. Some would use categorizations like "news, mystery drama, situation comedy, quiz-audience," while others used "documentary, crime-detective, comedy-variety, game shows" to cover the same content. Obviously, these variations posed problems for researchers trying to test for effects of television viewing, given that the results independent investigations were not directly comparable.

Instead of subjective classifications of content, Watt and Krull argued that "structural or form characteristics of the program may also have an effect on the audience"; therefore, they proposed a "content-free measure of television program form" that applied "information theory entropy terms" to features that appeared on television screens (1974, p. 44–45). In a study of adolescent viewing, they developed several formulas for measuring various aspects of a broadcast. For instance, "verbal time entropy is defined as the degree of randomness of the time of audible behavior on the part of characters in a program"; a formula measured this in terms of a negative, logarithmic function of the time that a series of television characters produced audible sound. I do not need to reproduce Watt and Krull's various formulas to convince you that, although they did

indeed carefully measure "nonrandom viewing patterns," their results are difficult to interpret in terms of what normally concerns us about television viewing and its effects.

Nevertheless, Ritchie (1991) describes Watt and Krull's work as among the more successful applications of Shannon's entropy measure, along with Seth Finn's studies of unpredictability in news articles (1985 and 1986). Less successful, in Ritchie's view, were attempts by Garner (1962) and Hsia (1968) to apply entropy to neurologic and cognitive information processing.

Eventually, the Shannon and Weaver model came to be seen as inadequate for expressing many of the important features of human communication. As early as 1969, Donald MacKay complained that

> communication engineers have not developed a concept of information at all. They have developed a theory dealing with only one particular feature or aspect of messages "carrying" information — their unexpectedness or surprise value. (pp. 56–57)

Nørretranders (1991/1998, p. 96) observes that Shannon's view of information equated it with "something completely meaningless, something closely related to disorder … quite unlike what the rest of us understand by the everyday word 'information' — meaning, content, overview, order." It is what Søren Brier (1992) calls a "mechanistic concept of information," which reduces human cognition to the level of computer processing. Shannon's so-called "Information Theory" simply did not adequately reflect the way in which people interpret and assess the "meaning" of messages. As the Canadian sociologist Orin Klapp (1982) concluded:

> Meaning, being subjective, and referring to synthetic or holistic properties that cannot be reduced to the sum of parts, might be called a higher sort of information that does not come easily, let along inevitably, from a growing heap of mere information. (p. 58)

3.2.2 Five Problematic Issues in Defining Information

Despite its popularity, Shannon and Weaver's implied definition of information contains several assumptions and requirements that differ with the ways we usually think about and experience similar phenomena in everyday life. Their definition is useful only in a very limited sense.

The Shannon and Weaver definition is not alone in posing such problems. Most information concepts contain assumptions regarding five issues that often turn out to be problematic when we try to apply their definitions. The five types of assumptions are about the following:

Utility: Does information, in order to be information, have to have some kind of effect, some sort of usefulness for humans? If not, what would be the

point of talking about it? In particular, must information reduce *uncertainty* about something? If information does not reduce uncertainty, must it be *useful* in some other way — e.g., in providing entertainment or some other kind of useful stimulation?

Physicality: Must information always take on some physical form, such as a book, the sound waves of human speech, or a natural object that embodies some kind of data? Is it even proper to discuss what people know, or believe, as being information? A related, and perhaps distinct, issue is whether information (or at least its effects) must be directly *observable*. If the effects are not directly observable, then how can it be the subject of scholarly study? This latter question bears on Belkin's (1978) seventh and eighth requirements of an information concept, which he calls methodological, and will be addressed in Chapter 6.

Structure/Process: Must information be structured in some way? That is, must it be composed of elements in fixed relations to one another, or in some way consist of a complex "whole," such as an image? Or is information a *process*, some kind of function, a series of steps — a sort of recipe?

Intentionality: When studying information, is it necessary to assume that someone (or something) *intends* to communicate it to another entity? Or is some information simply out there in the environment, to be perceived and interpreted by a sentient organism? For instance, we can imagine circumstances in which information is not communicated with a *purpose* in mind (requirement 1); a glance at threatening clouds informs us that rain is imminent, but in this case the generator of the message is an aspect of the natural world and has no intentions.

Truth: Must information, in order to be information, be *true*? Is it improper to call something information if it is demonstrably *false*? If so, then we need another term for that which is untrue, such as misinformation.

Let's examine each of these issues in turn, and consider what various authors have written about them.

3.2.3 Utility as a Requirement

As Fred Dretske says (in "Putting information to work," his essay in a volume about language and cognition), the concept of information isn't fruitful if it doesn't account for an effect of some kind:

> Information isn't much good if it doesn't do anything. … a difference that doesn't make a difference isn't really a difference at all …. I mean a causal difference, a difference in the kinds of effects it has. (Dretske, 1990, p. 112).

Dretske's concern is the relationship of "information" to causation and hence explanation of behavior; he doesn't think that information is the same thing

as a "belief" or a "meaning." We can accept Dretske's claim at a superficial level: it is not worth discussing a concept that makes no "difference" in the world. Yet this leaves many questions unanswered: Exactly what, how, and when are these effects?

First, it is necessary to say something about the relationship between information (or knowledge) and power (see Braman, 1989, 2006, for a fuller discussion of this topic). Suffice it to say that information can have powerful effects on humans, but usually does not. Yes, it is easy to imagine that, if we knew in advance which team would win the World Cup or which stock would increase in value, we could easily turn that information into a large sum of money — which in turn could be used in various, powerful ways — but the accurate prediction of future events is rare. Of course if we know other people's secrets we may be able to compel them to do our bidding by threatening to disclose the secrets — an unusual and perverted kind of power. And it is true that having specialized knowledge (e.g., of medicine) may grant one certain privileges and enable one to attract money. But such "formal knowledge" is closely bound to issues of performance, competence and (especially) institutions and social relations. As Eliot Freidson, (1986) says, knowledge must have agency in order to exercise power. Many discussions in the "information is power" vein tend to underplay the complex social relations (e.g., organizations like universities, governments, and corporations) or material objects (e.g., properties or weapons) typically involved in accumulating, maintaining, and using power.

In contrast, most of the "information" in our possession has little value or effect in and of itself. Most of what we know results only in subtle changes or uses in the real world. Some examples of relatively "powerless" information: the current time and temperature; the names of capitals of the world's nations; or what the person next to me just said.

Another utility of information is one in which there has been much more scientific interest and evidence: the ability of information to reduce uncertainty. From the 1950s through the 1970s, definitions of information proliferated, most of them incorporating the uncertainty aspect of Shannon's model. A review by Bouazza (1989) reflects the majority view regarding the role of uncertainty in these definitions: "The most cited and perhaps the most useful definition of information is 'that which reduces uncertainty'" (p. 145).

In the interest of brevity, we will ignore definitions that try to preserve major portions of Shannon's definition (e.g., those discussed by Artandi, 1973, and Fairthorne, 1975), as they are too narrow to be compatible with commonsense notions of information. The most common drawback of these early attempts is that they insist on defining information in terms of uncertainty reduction — typically in the execution of a choice or decision. For example, Wersig and Neveling (1975) declare that

> The basic term "information" can be understood only if it is defined in relation to … the information needs of people involved in social labour …. Either as reduction of uncertainty caused by communicated data. Or as data used for reducing uncertainty. (p. 138)

Like many such definitions, Wersig and Neveling's implies that information must be useful ("involved in social labour") and intentional ("communicated").

Similarly, Everett Rogers defines information in terms of reducing uncertainty in a decision task, as "patterned matter-energy that affects the probabilities of alternatives available to an individual making a decision" (Rogers, 1986, p. 85). Other writers leave out the assumption that a task is being performed, but they still cling to the uncertainty component, in which information is whatever "removes the doubt, restricts the uncertainty, reduces the ignorance, curtails the variance" (Nauta, 1972, p. 179).

The emphasis on uncertainty continues to current times. For example, one book on the nature of information begins with the words "The concept of information, which is the subject of this book, is intimately connected with the concept of uncertainty … information in a given context is obtained by a cognitive agent whenever relevant uncertainty is reduced" (Klir, 1996, p. VII). This is a typical approach for defining information among economists. Hirshleifer (1973) for example, discusses the probability of signals but draws a contrast with the way that probability is applied (p. 31):

> Uncertainty is summarized by the dispersion of individuals' subjective probability [or belief] distributions over possible states of the world. Information, for our purposes, consists of events tending to change these probability distributions. A rather different concept of 'information' is employed in communications and statistical theory, according to which a dispersed probability distribution is called less 'informative' than a concentrated one. This latter concept uses the term 'information' merely as a negative measure of uncertainty.

It is important to note once again that while this writer refers indirectly to Shannon's work, he is actually discussing epistemological probability — likelihood estimates in the "real world" of human communication.

The idea that information must be useful to be information has been undermined in several critiques, most notably by Fox (1983) and Losee (1997). The latter observes that

> a good definition or theory of information … should bear some resemblance to the natural language notion of information but need not adhere to it when the natural language definition loses its generality and explanatory power. This happens when the common language definition of information, for example, becomes conflated with the notion of *useful* information, that is, information is understood to be in all cases useful. For those accepting this concept of information, if it is not useful, it is not information. Requiring that all information be useful limits the domain

> of discussions about information to cognitive processes that can "use" something; it excludes the information carried by a subatomic particle which is not sensed by a cognitive process. We try to avoid excluding information phenomena. (p. 257)

Neither must information (intentionally communicated or otherwise) automatically reduce uncertainty. To use an example from Fox (1983), suppose that I tell you something but you do not believe me. I have not reduced your uncertainty. Or suppose I tell you that the stock market crashed this morning. Last you heard, the market was going up, so perhaps I have reduced your uncertainty about the overall direction of the market (assuming you have been wondering about it), and yet I have probably created uncertainty within you regarding collateral knowledge (e.g., the values of your individual stock holdings). As Fox points out, there are other scenarios in which the communicating of information might actually increase uncertainty, rather than decrease it.

Some other disciplines that initially exploited uncertainty reduction have recently questioned the ubiquity of such a psychological drive. For instance, in the interpersonal communication literature, we have the emergence of Problematic Integration Theory (Babrow, 1992) and Uncertainty Management Theory (Babrow, Kasch, & Ford, 1998). Both of these theories question the assumption that humans always strive to reduce uncertainty. While most discussions emphasize the negative effects of uncertainty, some other scholars (e.g., Brashers, Goldsmith, & Hsieh, 2002; Huber & Sorrentino, 1996) identify positive psychological effects of uncertainty — or instance, it may provide "hope."

Uncertainty Management Theory, in particular, highlights how people sometimes deliberately *increase* uncertainty. Uncertainty Management Theory holds that uncertainty is experienced "not simply as an uncomfortable tension demanding reduction" (Bradac, 2001, p. 463) but as feelings and cognitions that can be managed in other ways as well; these may include "seeking instead ambiguity and even confusion" (Bradac, 2001, p. 471). This is because "individuals may use uncertainty as a tool … sometimes this cognitive state will be cultivated, rather than eradicated" (Bradac, 2001, p. 464).

Two examples of the deliberate increasing of uncertainty in interpersonal conversation are apparent when a physician must deliver a threatening diagnosis to a patient. One party to the dyad, the physician, might choose to provide an uncertainty increasing message when he or she believes the patient is certain of bad news (Ford, Babrow, & Stohl, 1996); the patient, in turn, might avoid information in order to maintain uncertainty, or even seek out uncertainty increasing information (Brashers *et al.*, 2002). In both cases, increased uncertainty might actually provide some increase in comfort for the patient, even though in a way that might compromise his or her treatment. Afifi and Weiner (2004) give other examples in the health care context whereby individuals deliberately "avoid relevant information" (p. 182).

Other scholars have also debated the effects of new information on uncertainty. Lang, Newhagen, and Reeves (1996) imply that cognitive capacity limits may prevent new information from reducing uncertainty. Berlo (1977) notes that information *always* reduces uncertainty in the "now," but in the long term it may have the opposite effect. Yovits and Foulk (1985) conducted an empirical study in which they tested the assumption that information always reduces uncertainty; they found that sometimes new information made their subjects *less* sure that their evaluations of a problem were correct. Similar conclusions are reached by Kellermann and Reynolds (1990) and Robertson (1980).

Although uncertainty is not satisfactory as a basis for defining information itself, it is nevertheless an important concept for information seeking. Even though information can be encountered in a passive way, actively acquiring information implies recognition of uncertainty or anomalies at some level. Kuhlthau (1993b) makes good arguments for considering uncertainty as a beginning stage in the process of finding information, and Yoon and Nilan (1999) demonstrate that one cannot study uncertainty without considering what informants already know (i.e., certainty).

What about other effects of information? That is, if information does not always reduce uncertainty, must it have some other utility to be considered "information"? Some authors include in their definitions of information almost any kind of stimulation that humans find useful. Examples of such stimulation could include sound (from music or from a waterfall); sight (the words of a novel, the images of a painting, a photograph, or a film), or touch (the feel of warm sunshine or cool water on skin). Each of these sensations "tells us" something. In Chapter 5, and obliquely below under "Truth," I argue that such stimuli include potentially useful information. Therefore, if information must have an effect, it should extend to outcomes beyond "reducing uncertainty."

3.2.4 Physicality as a Requirement

Everyone acknowledges that information *can* have a physical form (e.g., see Buckland, 1991a, and McCreadie & Rice, 1999), but few explicitly argue that it *must*. Indeed, many scholars take pains to state that a more useful conceptualization of information is as a phenomenon that exists apart from physical media; that is, that we should *not* think about information as primarily something found in human-created messages like printed texts.

However, as Klaus Krippendorff (1984) has pointed out, at some level information must have a physical form. He argues in favor of information defined as "*a change in an observer's state of uncertainty* caused by some event in his world" (sic, p. 49). This, of course places Krippendorff's definition in the "uncertainty

requirement" camp we have already discussed. But the interesting aspect is how he analogizes information to *energy*:

> First, neither energy nor information exists in a vacuum. Both are embodied in material processes to which one must refer. Just as one can speak of energy only in conjunction with some specific resource, fuel or storage capacity … so one can speak of information only in conjunction with a physically identifiable source, a message or a situation as described by an observer, and relative to what he already knows. Second, energy and information are measures of work … information is a measure of the (intellectual) work required to distinguish, to a degree better than chance, among a set of initially uncertain possibilities. (pp. 49–50)

Certainly information in the sense of *thoughts* has a physical dimension: the electrical impulses of a human nervous system. In any event, it does not pose much of a restriction to contend that information must have a physical component, in the sense that energy does. In Krippendorff's case, it is much more of a restriction to require that information reduce uncertainty — as his Shannonesque conceptualization makes clear.

3.2.5 Structure/Process as a Requirement

Other families of definitions avoid the uncertainty concept through use of analogy — typically to a structure or process — and sometimes require intentionality to do so. Kenneth Boulding (1956) used the analogy of an *image*, or a "picture in our head" in his popular characterization of messages and meaning. In Boulding's view (1956, p. 7), "the meaning of a message is the change which it produces in the image" — i.e., the image of reality (or a portion of it) that exists in someone's mind. This conception of information is similar to the one offered by Bateson at the beginning of this chapter, defining "change" as "difference which occurs across time" (1972, p. 452).

Expanding on Boulding's analogy, Pratt (1977) defines information as an *event*: "That which occurs within the mind-upon-absorption-of-a-message" (p. 215). That is, information (or an "informative event") is what we call a change in one's mental image. For Pratt, then, information is the event that changes someone's image of reality. Like those of Boulding and Bateson, Pratt's definition has ties to the "Internal Information" described by Dervin and Rubin earlier in this chapter.

The "image" metaphor is evoked by Donohew and Tipton (1973) as well. But, for them, the idea of "image" is not something like a holistic picture, but rather a complex mental structure of parts and subparts:

> An individual's "image of reality" is divided into three parts. First are the goals, beliefs, and knowledges [sic] which an individual has compiled as a result of his lifetime

> of experiences. These cognitive "objects" are defined as any concepts, issues, material objects, or ideas which exist psychologically for a person …. The second part of an individual's image or reality is the concept of self. This includes an evaluation of his ability to cope with various situations …. The third part of the image of reality is an information-handling "set" developed out of past experiences. The "set" probably controls the selection of information used by the individual to cope with the environment. here we are talking about an individual's information-seeking and processing "styles." (pp. 246–247)

Similarly, MacKay argued that information must be considered in the contest of a hierarchy of goals (Cornelius, 2002, p. 413).

Other authors have conceptualized information as a *structure* or *organization* of experience and sensory data, for example, Thompson (1968) and Belkin and Robertson (1976). Following Thompson's definition, Belkin and Robertson (1976) state that "information is that which is capable of transforming structure" (p. 198) — in other words, it changes the knowledge state of the recipient. A parallel characterization comes from MacKay (1969), in which information is "that which does logical work on the organism's orientation" (p. 95).

Belkin (1978) notes that characterizing information as something that transforms knowledge structures has its problems, but it relates well to information as it has been defined in a variety of disciplines. Given that information-as-process assumes that a process has an effect on some entity — as an alteration of a mental image, or the creation of meaning in a human mind — the process and structure views of information are analogically similar. In some definitions of this type, individual authors have added one or more restrictions to serve their purposes. Belkin and Robertson (1976), for example, are concerned with document retrieval systems and therefore assume that messages are intentional and that messages are represented by *texts*: "a collection of signs purposefully structured by a sender with the intention of changing the image-structure of a recipient" (p. 201).

Charles Cole (1994) notes a dilemma that accompanies the assumption that information changes a cognitive structure: if "new" information can modify knowledge structure, then it must be so that "old" or "expected" information does not modify knowledge structures in the same way, or at least at the same time. New, or "pure," information must be extremely rare because such information is completely unanticipated, and there is a natural tendency not to recognize, see, or perceive that which is unanticipated. Information, then, has the quality of being unexpected and expected, old and new, at the same time. Therefore, for information to be unexpected and expected, old and new, at the same time, information must enter the perceptual system in at least a two-stage process.

More recently, Robert Losee (1997) has advanced a general and coherent definition of information. He attempts to resolve some of the conflicts between

definitions of belief, knowledge, information, and misinformation by viewing information generically as processes that produce outputs. The processes, or functions, may be invoked by humans, or machines, or other entities. The inputs into the process can be perceived from the environment or retrieved from human memory. The output of the process (e.g., the value taken on by a variable) is informative about both the original inputs and the process that produced the output from those inputs. Thus, Losee defines information as "the values of characteristics in the processes' output" (p. 256).

In Losee's view, by examining any output we can usually infer something about the process that created it. Examining a tree, for example, informs us about its origins, soil, moisture, and growth process. Or a cake, which is created through a procedure that includes ingredients, instructions, and heating, may be inspected to determine some, but not all, of the ingredients and the process by which it was created.

Defining information in terms of the output of a process, Losee concludes, moves beyond discipline-specific definitions (such as the tendency for decision theorists to define information in terms of uncertainty reduction) and provides a link between various studies of information. Yet, while Losee's definition sidesteps some of the criticisms of Fox regarding information-as-process, it substitutes the vagueness of "process" with a mysterious "function" that takes input and returns a value to be attached to variables (or "characterizations"). This in turn begs the question of how variables emerge in the first place and what determines the nature of the functions. These are not necessarily questions that Losee is responsible for answering, but rather problems to be faced by researchers trying to apply his definition of information. Hörz (1996) is yet another commentary on the notion of information as structure or process.

Fox (1983) criticizes all structure-based definitions as failing to provide a clear definition of "structure" itself. Fox also makes compelling arguments that information cannot be considered either an event or a process—although he also provides counterexamples supporting the process view of information.

Fox himself favors defining information as a type of "telling," as represented in propositions. It would be impossible to fairly convey Fox's arguments in any shorthand version, presented as they are in 213 pages. It may suffice to say that his is the most extended dissertation on the subject thus far. Fox summarizes his conclusions in this way:

> Information need not be true, though misinformation must be false; information need not be believed by anyone; information need not originate with a reliable informant, but it must originate with someone in an appropriate position to know. Ontologically, information is propositions [the identification of which] depends on contextual factors. (pp. 212–213)

Fox admits that his conclusions leave several issues unresolved, including the

> crucial notion of the *amount* of information carried by a set of sentences remains unanalyzed. The notion of *informativeness* remains unanalyzed .... The details of how meaning determines propositional content as a function of context is not well understood. (p. 213)

In the intervening years since Fox's book, Tor Nørretranders has published (1991/1998) a text that addresses the relation of context to content. Nørretranders introduces the term *exformation* to describe the ways in which messages may refer to a "mass of information" that is "not present" and "explicitly discarded" but nevertheless is understood to be relevant by the receiver and is used in construing the meaning of a message (p. 92).

Nørretranders provides two examples to illustrate the concept of exformation, one involving an extremely short message and the second no message at all. The first example is Victor Hugo's famous query to his publisher regarding the appearance of his latest novel, *Les Misérables,* in 1862. On vacation and out of touch with news about public reaction to his work, Hugo mailed a letter consisting of a single character: "?" His publisher replied, simply, "!" Without prearrangement, both parties understood these exchanges to mean something like the question "How is my book selling?" and the response, "Surprisingly well!"

Nørretranders's second example corresponds to the saying "no news is good news." When parents do not receive a phone call from their son away at college, they assume that he is OK and that things are fine. Information has been conveyed without sending a message at all. This example echoes Cole's (1994) observation about "new" information versus "old" or "expected" information: can "no news" be viewed as merely preserving the original knowledge structure — or does it still modify the structure, but in a different way?

3.2.6 Intentionality as a Requirement

The manner in which Fox characterizes information has a critical limitation. His analysis is based, by necessity, on propositions expressed in the form of sentences. ("In this work I deal *only* with information carried by sentences," 1983, p. 7). Fox notes that his propositions represent "*what is asserted to be the case by (someone who writes or utters)*" (p. 77). One problem with this limitation is that it takes us back into the assumption of a message intentionally sent by a sender to a receiver.

We could call this type of intentionality the "communication assumption" — that information necessarily involves communication, and hence, intention to communicate. Bowers and Bradac (1982) see the presence of intentionality as a

key dividing point among rival definitions of "communication." Their examination of 27 metatheoretical discussions of communication finds that 18 of their authors hold that intentionality is a requirement for communication to exist. Few of those theorists have an unusual definition for "intention"; most mean the concept in its usual sense: a "purposeful activity … [that] must be explained by 'in order to' as well as 'because' statements" (Bowers & Bradac, p. 7).

Although the restriction of *intentionality* may hold true for what is the most important sense of information — the exchange of information between humans (e.g., see Buckland, 1998) — it does not apply to all senses in which we use the word. Information may originate outside natural language propositions, for example, as signs occurring in our environment. Whether we are viewing the natural world (e.g., trees, animals, rocks) or the human-made world (e.g., what people are wearing and doing, or a printed sign that says "exit"), we can take in stimuli that have meaning. The only way to retain the notion of intentionality is to assume that it can refer to *either* a "sender" ("someone who writes or utters") or "receiver"(the viewer of the world), but does not necessarily involve both ends of a communication process.

If we believe that people must *intend to receive* in order to take in information, then information is, in this more limited sense, intentional. Intentionality solely on the part of the receiver was suggested by Westley and Maclean in 1957, and in a discussion of news-seeking behavior, by Westley and Barrow (1959). The latter described "the need of the selecting receiver to be oriented in his extended environment" (p. 431); this assumption would take in the kind of "viewing" that I discussed previously. Theirs was a rather radical conception of communication, because it did not assume that a sender's intentions were involved; hence, Bowers and Bradac count it among the "nonintentional" definitions of communication. However, it *is* an intentional view of information behavior. This is a different view from that of Stonier (1990, p. 21), who claims that

> Information exists. It does not need to be perceived to exist.
> It does not need to be understood to exist.

3.2.7 Truth as a Requirement

Losee (1997) also considers the notion of "misinformation." He notes that information can have various flaws, including inaccuracy, incompleteness, lack of justification, and intent to deceive. Do we need a special label for information that is so flawed as to be untrue?

Traditionally, philosophers have made a distinction of this type regarding *knowledge*, the common stance being that knowledge is "justified true belief." In this definition, belief is taken to be "the most elementary of our opinions … characterized by two qualities: … either true or false ... arrived at either rationally

or nonrationally" (Cherwitz & Hikins, 1986, p. 31). By *justified* is meant that the believer has *sufficient, relevant evidence* that his or her belief is true. The "justified true belief" definition of knowledge has been criticized since the analyses of Russell (1959) and Gettier (1963) but continues to have many advocates. More to the point, no major philosophers have extended the requirements of truth and justification to the concept of *information*.

Patrick Wilson's quote at the beginning of the next chapter suggests that the truth or falsity of information is something that we can ignore in discussing information in the abstract sense. For one thing, it could be argued that we rarely know for sure if something (a statement or perception) is true or not; even if a "fact" is demonstrated to be true at this moment, it may be possibly proven wrong a few moments later. Fox (1983, p. 212) and Derr (1985, p. 496) also hold that information need not be true, based upon analyses of usage of the term in ordinary discourse. Buckland (1991b) concludes that

> the question of whether specific bits of knowledge are true is not central to our concerns. We adopt the position that the process of becoming informed is a matter of changing beliefs. Whether these beliefs are held or denied by others and whether they are compatible with some *a priori* or fundamental assertion need not detain us. (p. 43)

Some would disagree with this point of view and instead argue that a true–false distinction is worth keeping in defining "information." Frické (1997), for example, argues that information should be "truthlike" in order to "fit the world" so that we can "succeed in our interactions with the world" (p. 888). Dretske (1981, 1983) makes a similar case, that information must tell us truly about a state of affairs, such that we can learn from it; he concludes that false information and misinformation cannot be considered to be varieties of information, but rather distinct concepts.

However, we are concerned here with a broad view of information phenomena that fits both real life and empirical studies of real life, not with establishing a philosophical distinction. Studies of information seeking provide many examples in which people value information that they know not to be entirely true. For purposes of this text, then, we will generally ignore any distinction between the truth or falsity of information, unless such is the focus or finding of a given investigation.

3.3 Must There Be a Universal Definition of Information?

All of the definitions we have examined have taken a stance on one or more of these issues. The distinctions and disagreements among reviewers of

definitions are too many to resolve; in short, there is as yet no single, widely accepted definition for the concept of information. At least among recent reviews, however, there has been some agreement on the *types* of definitions of information that exist.

To summarize the chapter thus far, we can see that there have been many attempts to characterize information, some of them quite broad (e.g., the Image/Event/Structure/Process definitions), while others have been very narrowly focused (e.g., the view of information as a selection of signals from a well-defined set of symbols, the reception of which may reduce uncertainty for the receiver of the signals).

Narrow definitions assume one or more of the restrictions discussed earlier in the article. They hold that information must be *useful*, or that its transmission is *intentional*, or that it must be *represented* in an recordable medium (in written or spoken language, or images), and/or that information must be *true* (or at least easily verifiable). Shannon's model contains examples of all of these assumptions. The vast majority of the early definitions and investigations of information seeking include at least the first three of these assumptions.

Before we go any further, it is important to note that defining information in an absolute and final sense is not entirely necessary for the study of information phenomena to proceed. As Artandi (1973) and others have pointed out, all we need are *useful conceptualizations* of information. Belkin (1978) makes this point most effectively when he says,

> we are not concerned with *definitions* of information, but rather with *concepts* of information. The distinction is that a definition presumably says what the phenomenon defined *is*, whereas a concept is a way of looking at, or interpreting, the phenomenon … by accepting the idea of a concept one becomes free to look for a *useful* concept, rather than a universally *true* definition of information. (p. 58)

If we wish to keep talking about "information," we may have to give up trying to define it rigorously. Carl Hempel (1952) notes that there are some terms in any conceptual scheme that are so basic that they need not be fully explicated. Hempel calls these basic concepts "primitive terms." Primitive terms are simply accepted as they are commonly understood. Chaffee (1991, p. 7) provides the example of the concept of a "person," or a "human." Perhaps there are some fields in which what we mean by "human" needs to be carefully defined and is subject to debate — in zoology, for example. But, for most purposes of study, we do not need to explain that particular notion. It is when we deal with concepts that *build upon* the notion of humans — family, community, society — that we are in need of careful definitions for those concepts.

Information can be, and has been, treated as a primitive term as well. Some writers believe this approach is problemmatic — see Frohmann (2004, p. 86) and Nunberg (1996, p. 110). Yet it has been a common practice in the

IB literature; commenting on a variety of recent studies, Pertti Vakkari (1997) notes that

> one of the striking features in many studies was the use of the central concepts, like information, knowledge, information need, seeking, and use as primitive concepts, i.e., without definition. (p. 460)

Can we reconcile the various definitions of "information" with one another? It does not seem so, and perhaps it is not necessary. Although there is scholarly disagreement over the "most rigorous," or "most easily quantifiable," or "most productive," or "most parsimonious" meaning of "information," these debates have done little to promote a fuller understanding of the concept among a community of scholars. In fact, if anything such discourse has resulted in a fracturing of scholarly effort in studying the phenomenon of information; it has resulted in too many definitions that defy comparison and that provide no common basis for understanding. Thomas Allen (1969) and Brenda Dervin (1977) discussed using the concept of "communication" instead (see the insightful discussion by Bernd Frohmann, 2004, pp. 53–67). Similarly, Jonathan Furner (2004) argues that there are so many productive substitutes for the concept of "information," that we could do without it all together:

> … philosophers of language have modeled the phenomena fundamental to human communication in ways that do not require us to commit to a separate concept of "information." Indeed, we can conclude that such a concept is unnecessary for information studies. Once the concepts of interest have been labeled with conventional names such as "data," "meaning," "communication," "relevance," etc., there is nothing left (so it may be argued) to which to apply the term "information." (p. 428)

Instead, let us treat "information" as a primitive term, as a phenomenon that we all recognize when we see it in its various forms (Fox, 1983, p. 16). Information would then be treated as "anything that exists psychologically for a person" (Carter, 1965; Chaffee, 1991, p. 9). We have only to look around us to establish the fact that information exists in the form of physical objects (what Buckland, 1991a, calls "information-as-thing"); and hundreds of studies have documented that people believe that information exists as a psychological object as well — a disembodied result of "becoming informed."

Fox (1983) observes that the "ordinary notion of information" is one through which "information scientists apparently do succeed in communicating with one another quite effectively regarding information and related concepts" (p. 5). Nunberg (1996, p. 110), as well, notes that " 'Information' is able to perform the work it does precisely because it fuzzes the boundaries between several genetically distinct categories of experience."

Allowing a broad definition of information poses problems for operationalization and measurement of concepts, as shall be seen as individual studies are reviewed in later chapters. Yet to argue for any tighter definition of information would be to limit the scope of this book, which is intended to review a broad spectrum of investigations having to do with information seeking and sense making. Therefore, in this text, I allow for any definition of information, however vague or difficult to study. Where more restricted definitions of information apply in the review of individual theories, methods, or studies, they will be made explicit.

It should be noted that the definition "any difference that makes a difference" places at least *one* important restriction on the scope of information: it rules out the possibility of information existing independently of a knowing mind. For the purpose of this text, we will assume that a conscious brain must be engaged *at some point* for information to be said to exist. Otherwise, we are back to the unhelpful stance that "*everything* is information."

Two examples, the first suggested by Fox and the second by Buckland, will help to make the restriction clear. First, Fox provides the example of someone who keeps a secret diary that no one else is ever allowed to read. Some definitions of information would imply that, since the content of the diary was never *communicated*, that it cannot be considered information. (Fox uses this straw man to defeat the requirement that a message *must* be transferred—i.e., received—to qualify as information.) Of course, a diary is a clear example of information-as-thing, and the symbols written in the diary are an expression of a human mind—it is some kind of message, even if never received by any other than its creator. So, yes, a secret diary (an unviewed, human-created record) can be safely considered to be information.

In the second example, trees could be viewed as carrying information in the form of their growth pattern of rings, which among other things tell us about the amount of rain that fell in a past season. Even if no person has viewed that information, is it not still information? For our purposes, the answer is "no." It is nothing more than wood until someone both encounters *and* makes some sense of it. So, if a tree falls in the forest and there is no one there to see it, then it conveys no information.

To conclude this portion of the chapter, it bears emphasizing that in this text we will consider only *human* information behavior, and the making or meaning or sense, and therefore we interpret information as requiring the involvement of a *human* mind. (It could be easily argued that *animals* use information, but they are simply outside the scope of this book; see Bates, 2005b, for a distinction between animal and human use of information.) As will be seen in later chapters, a broad conceptualization of information is in keeping with the way the term has been employed in studies of information needs, uses, seeking, and sense-making.

3.4 Distinctions among Information, Knowledge, and Data

A side issue as regards information seeking research is worth noting. Much attention has also been granted to defining the concepts of "data" and "knowledge." Machlup (1983) examines the issue of whether *information* is synonymous with *data* and *knowledge*, noting that there has been a tradition to treat the three as a hierarchy, with data at the bottom and knowledge at the top. Raber (2003) raises a troubling question about such an arrangement when he says "But at what moment and how does information become knowledge?"

Machlup holds that historical usage of the three terms does not fully justify the distinction that information is data that has been processed and/or organized. The origins of the term in the Latin *dare*, "to give," along with the history of its usage, imply that the word data ("the givens") can be assumptions, facts, measurements, and so forth, expressed in either words or numbers. As Machlup points out (p. 647), many writers claim that data are a "raw" type of information, while a few others see information as a type of data. Machlup concludes that there is neither precedent nor need to establish a hierarchy between the two words.

The common notion that knowledge is information that has been sifted, organized, and understood by a human brain is on firmer ground. Brown and Duguid (2000) complain that the two concepts are unfortunately conflated:

> People are increasingly eager that their perfectly respectable cache of information be given the cachet of knowledge. Such redefinitions surreptitiously extend the overlapping area where knowledge and information appear as interchangeable terms. Nevertheless … there do appear to be some generally accepted distinctions between knowledge and information …. For example, it sounds right to ask, "Where is that information?" but odd to ask, "Where's that knowledge?" (p. 2)

Machlup (1983) makes the useful point that "information is acquired by being told, whereas knowledge can be acquired by thinking" (p. 644). Through our inner experience of thought, we can form new knowledge without taking in new information from the external environment. Information implies *transfer*, says Machlup, while knowledge is a *state* ("knowing"). Knowledge and information are therefore not usually the same, except that "information in the sense of that which is being told *may* be the same as knowledge in the sense of that which is known, but *need not* be the same" (p. 644). Robert Hayes (1993) makes a somewhat different point when he says that "knowledge is internal; it cannot be received but must be internally created" (p. 5).

Other authors sometimes raise the issue of truth, discussed earlier, in the knowledge-information distinction back to the truth issue discussed earlier,

e.g.,: "The relationship between knowledge and truth is especially problematic" Raber (2003, p. 8). However, Dretske (1981, p. 45) makes no distinction between the two in regards to a truth requirement: "information is what is capable of yielding knowledge, and since knowledge requires truth, information requires it also."

Decades of arguments about distinctions among the words data, information, and knowledge (and sometimes "wisdom," too) have not prevented the continued use of terminological hierarchies. As Marcia Bates (2005b) points out, a number of authors make such distinctions, a recent example being the paper by Houston and Harmon (2002). Bates herself sees five categories of information-like concepts, although these are not strictly hierarchical to one another. Bates uses the terms *information 1* ("the pattern of organization of matter and energy"), *information 2* ("some pattern of organization of matter and energy that has been given meaning by a living being"), *knowledge* ("information given meaning and integrated with other contents of understanding"), *data 1* ("that portion of the entire information environment available to a sensing organism that is taken in, or processed, by that organism"), and *data 2* ("information selected or generated by human beings for social purposes").

In this book, the usage of the terms *data*, *information*, and *knowledge* will generally be used synonymously, because they are usually not clearly delineated in studies of information behavior. Knowledge, however, is strictly a phenomenon of the human mind, whereas data and information are often represented by tangible, physical objects. That information usually has a physical manifestation has often been the key consideration in past studies of information seeking. The way that information seeking is typically approached under the new paradigm, though, is in the sense of knowledge — something in someone's mind — not primarily as a physical object.

The usage of data, information, and knowledge outlined above represents a necessary simplification of the many definitions and examples that have been discussed in dozens of scholarly works. However, the fine distinctions made between data, information, and knowledge are of little value in most studies of information seeking. This book will treat information as a broad concept, encompassing instances that would be considered unusual by some scholars.

3.5 Summary

This chapter has explored the central concept employed in studying information seeking: information. We have seen that there are widespread disagreements about what would constitute a general definition of information. Most of these disagreements concern the issues of truth, physicality, intentionality,

uncertainty, and utility. The most common types of definitions that have emerged assume that information is something that either reduces uncertainty or changes one's image of reality. In this chapter, I provide examples that suggest that a truly universal concept of information would need to fulfill at least the following requirements:

1. allow for common-sense notions of information used in everyday discourse;
2. allow for unintentional origins of information (e.g., observations of the natural world) as well as for purposeful communication among people;
3. allow for internally generated information (e.g., memories, constructions) as well as externally generated information (e.g., reading a text);
4. allow for types of information beyond that needed for "solving a problem" or "making a decision";
5. admit the importance of informal sources (e.g., friends) as well as formal sources (e.g., data or documents); and
6. involve the human mind, either in the creation, perception, or interpretation of information; to leave out such a requirement is to declare that anything is information and that would leave us with no focus in our investigations.

I have considered numerous distinctions made over the years, but I argue in favor of treating information as a primitive concept that is so basic to human understanding that it does not require a tight definition. To the extent that information needs a definition it must be a broad one, such as "any difference that makes a difference" — in essence, implying a change to the structure of a human mind. Such a characterization, vague though it is, would allow us to consider what many authors have said about information seeking without having to worry about whether they restricted their observations to phenomenon that must be true, observable, physical, intentional, and so forth.

In the next chapter, I will build on the initial discussion of information to define information needs. Following that, Chapter 5 ventures farther afield to consider more peripheral concepts and behaviors related to information seeking. A review of these other concepts is important in addressing several vexing questions about information-related behavior:

- Why do people seek information?
- What makes information relevant?
- Can information be found without intentionally searching for it?
- Is it possible to have too much information?
- Why do people sometimes avoid information?
- How does information differ from entertainment?

These and other issues are taken up in Chapters 4 and 5.

Recommended for Further Reading

Belkin, N. J. (1978). Information concepts for information science. *Journal of Documentation*, *34*, 55–85.

This lengthy article explains Belkin's view of information and articulates his concept of the Anomalous State of Knowledge (ASK) and how it is resolved.

Boulding, K. (1956). *The image: Knowledge in life and society*. Ann Arbor, MI: University of Michigan Press.

An oft-cited book by the unconventional thinker Kenneth Boulding. Boulding uses the analogy of an "image" to discuss how we come to know our world.

Capurro, R. and B. Hjørland (2002). The concept of information. In B. Cronin (Ed.), *Annual Review of Information Science and Technology*, (vol. 37, pp. 343–411). Medford, NJ, Information Today.

A comprehensive discussion of the history of definitions of information.

Frohmann, B. (2004). Deflating information: From science studies to documentation. Toronto: University of Toronto Press.

While focused on the discourse surrounding the concept of "scientific information," the initial chapters of Frohmann's book give a fascinating account of how information seeking, use, and other behaviors have been studied over several decades.

Schement, J. R. (1993). Communication and information. In J. R. Schement & B. Ruben (Eds.), *Information and behavior* (vol. 4, pp. 3–33). New Brunswick, NJ: Transaction Books.

Jorge Schement examines a variety of definitions of information. A companion article in the same volume supplies the history of the word itself.

Thayer, L. (1987). How does information "inform"? In B. D. Ruben (Ed.), *Information and behavior*, (vol. 2, pp. 13–26). New Brunswick, NJ: Transaction Books.

Lee Thayer's amusing essay considers several problematic aspects of information as the term is commonly used. He convincingly makes the point that information is always "from the perspective of some observer."