

Credibility: A Multidisciplinary Framework

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Introduction

This chapter reviews the theoretical and empirical literature on the concept of credibility and its areas of application relevant to information science and technology, encompassing several disciplinary approaches. An information seeker's environment—the Internet, television, newspapers, schools, libraries, bookstores, and social networks—abounds with information resources that need to be evaluated for both their usefulness and their likely level of accuracy. As people gain access to a wider variety of information resources, they face greater uncertainty regarding who and what can be believed and, indeed, who or what is responsible for the information they encounter. Moreover, they have to develop new skills and strategies for determining how to assess the credibility of an information source. Historically, the credibility of information has been maintained largely by professional knowledge workers such as editors, reviewers, publishers, news reporters, and librarians. Today, quality control mechanisms are evolving in such a way that a vast amount of information accessed through a wide variety of systems and resources is out of date, incomplete, poorly organized, or simply inaccurate (Janes & Rosenfeld, 1996).

Credibility has been examined across a number of fields ranging from communication, information science, psychology, marketing, and the management sciences to interdisciplinary efforts in human-computer interaction (HCI). Each field has examined the construct and its practical significance using fundamentally different approaches, goals, and presuppositions, all of which results in conflicting views of credibility and its effects. The notion of credibility has been discussed at least since Aristotle's examination of *ethos* and his observations of speakers' relative abilities to persuade listeners. Disciplinary approaches to investigating credibility systematically developed only in the last century, beginning within the field of communication. A landmark among these efforts was the work of Hovland and colleagues (Hovland, Jannis, & Kelley, 1953; Hovland & Weiss, 1951), who focused on the influence of various characteristics of a *source* on a recipient's message acceptance. This work was followed by decades of interest in the relative credibility of *media* involving comparisons between newspapers, radio, television, and the Internet (e.g., Meyer, 1974; Newhagen & Nass, 1989; Slater & Rouner, 1996; West, 1994). Communication researchers have tended to focus on sources and media, viewing credibility as a *perceived characteristic*. Within information science, the focus is on the evaluation of *information*, most typically instantiated in documents and statements. Here, credibility has been viewed largely as a criterion for relevance judgment (Barry, 1994; Bateman, 1999; Cool, Belkin, Frieder, & Kantor, 1993; Park, 1993; Schamber, 1991; Wang & Soergel, 1998), with researchers focusing on how information seekers assess a document's likely level of quality (Liu, 2004; Rieh, 2002; Rieh & Belkin, 1998).

This brief account highlights an often implicit focus on varying *objects of assessment* among fields and not merely variance in the relevant unit of analysis from one study to the next.

A field's perspective may for a time be primarily focused on a source, medium, or type of information. Each discipline recognizes that the credibility of sources, media, and information are fundamentally and intimately linked, but differences in implicit primary interest or focus have had, we believe, profound effects on the direction of credibility research. A researcher's focus can be on speakers, as was the case for Aristotle (*people* being more or less believable) and continues in interpersonal communication and psychological research; on larger aggregations (organizations or groups), as is often the case in the management sciences; on media (e.g., television or the Internet) as in mass communication research; on information resources (texts), as is common in information science; or on messages (claims, threats, or promises) and signals (often in the form of overt behaviors which *imply* claims, threats, or promises), as is often the case in consumer research.

Further, information technology is beginning to have a significant effect on credibility research, in that it highlights the need to reexamine what constitutes a perceived *source* and the blurring lines between traditional concepts such as source, message, medium, and receiver. This shift is clearest in HCI research (e.g., Sundar & Nass, 2000, 2001), where the focus may be on devices (*computers* or *information systems* are more or less believable) and on-screen representations of real-world sources (virtual characters); on information resources that merely filter, summarize, or otherwise manipulate data but are not the actual originators (e.g., portals, news filters, and search engines); and, by extension, on messages and signals that can be manipulated or distorted—in some cases, as a result of the recipient's actions or preferences—making one simultaneously recipient and source.

Several other challenges exist in examining the concept of credibility across disciplines. Not only do different fields address different sets of questions with different goals, but they inevitably introduce related but distinct constructs into the discussion: authority, quality, trust, and persuasion. In some cases, various terms are considered to be related to credibility and, in others, they are construed as underlying dimensions of the construct.

Scope

This is the first chapter devoted to the concept of credibility to appear in the *Annual Review of Information Science and Technology (ARIST)*. Two previous *ARIST* chapters have investigated the notions of trust and belief. Marsh and Dibben (2003) examined the role and impact of trust for information system practitioners and management scientists with an interest in social informatics. They did not cover social interactionist influences such as social capital, authenticity, credibility, and authority. Fallis's (2006) *ARIST* chapter addressed the notions of truth and belief from the perspective of social epistemology. He discussed truth and beliefs with respect to the accuracy of materials that libraries provide and how librarians help people to acquire *true beliefs*.

Beyond *ARIST*, a number of previous studies have reviewed the notion of credibility within specialized domains, such as credibility assessments on the World Wide Web (Danielson, 2005), or with respect to particular academic disciplines, such as communication (Metzger, Flanagin, Eyal, Lemus, & McCann, 2003).

This chapter differs from previous studies by discussing credibility in broader and more diverse contexts that encompass a number of academic disciplines. Nevertheless, as with previous reviews, we have set certain boundaries to the discussion. Our focus is on credibility in relation to the use of information technology. We occasionally examine research that is not

aimed at exploring this relationship (e.g., in the use of newspapers or in interpersonal face-to-face communication); we do so, however, primarily to illustrate the uniqueness of credibility evaluation in relation to human use of information technology. Where information technology employs increasingly human-like characteristics such as voice and virtual characters, user credibility assessments tend to mimic those of human–human interaction (Nass & Brave, 2005; Reeves & Nass, 1996). Where such social responses are not evoked through human-like characteristics, information systems introduce numerous unique pressures on credibility judgments.

The objectives of the chapter are:

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- To review critically the various conceptualizations and research approaches pertaining to credibility with respect to the use of information technology across multiple disciplines
- To examine concepts related to credibility and investigate relationships among them
- To identify multiple perspectives on credibility with respect to their applications to the design of information technology and critical thinking instruction for students
- To develop a multidisciplinary framework for credibility.

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Organization of the Chapter

This chapter begins by discussing types of credibility and related concepts such as quality, authority, trust, and persuasion. We then discuss the underlying dimensions of credibility in general and its problems. In the following section, both empirical and theoretical studies are examined across five broad domains in which credibility is investigated in relation to human use of information technology: information seeking and retrieval, management information systems, consumer behavior, health science, and evaluation of Web resources. The focus is on the identification of critical concepts and dimensions of credibility and the factors or criteria that influence the extent of credibility assessment. Then the three application areas of critical thinking instruction, Web design, and information system design in which the concept of credibility has become increasingly significant are introduced. Finally, a multidisciplinary framework for credibility and an agenda for future research is proposed.

Credibility and Related Concepts

In this section, we situate credibility in relation to other concepts. To do so, we first briefly discuss various types of credibility. Second, we examine concepts that, although frequently discussed together with credibility and sometimes confused with it, are not equivalent. Third, we address the construct's underlying dimensions, in particular how situation-dependent variables can lead to widespread disagreement regarding which terms (e.g., expertness, trustworthiness) ought to be considered as the core dimensions.

Types of Credibility

Credibility is frequently attached to objects of assessment, as in *source credibility*, *media credibility*, and *message credibility*, reflecting the fact that assessments of these objects differ (Kiousis, 2001). At the same time, however, credibility assessments of sources and messages are fundamentally interlinked and influence one another (Slater & Rouner, 1996)—that is, credible

sources are seen as likely to produce credible messages and credible messages are seen as likely to have originated from credible sources (Fragale & Heath, 2004). The extent to which source and media credibility assessments are interlinked, however, is less clear, perhaps in part because these have historically been investigated by different subdisciplines of communication. It is unclear, for example, if credible media are seen as more likely to introduce credible sources or if credible sources are seen as more likely to communicate via credible media.

For several decades, probably the best-known and most-employed media credibility comparison item was that used by Roper Research Associates for the Television Information Office: “If you got conflicting or different reports of the same news story from radio, television, magazines, and newspaper, which of the four versions would you be most inclined to believe?” (Roper, 1985). This question was aimed at discovering perceptions of the *relative credibility* of different news media. More recently, comparisons between the Web and traditional media have posed similar questions.

The problem with this approach is that such comparisons do little to illuminate either the specific *variables* that make one medium more credible than another (see Nass & Mason, 1990, for a general critique) or the processes used in evaluating different types of media and, more importantly, what characteristics of a medium influence credibility assessments (Burbules, 2001).

That credibility assessments themselves may be based upon distinct types of evaluations has been a focus of, among others, Fogg and his colleagues (Fogg, 2003a; Tseng & Fogg, 1999), who proposed four types of credibility in assessing information systems: presumed, reputed, surface, and experienced. *Presumed* credibility describes how much the perceiver believes someone or something because of general assumptions in the perceiver’s mind. For example, people may assume that their friends tell the truth but view salespeople as lacking in credibility. *Reputed* credibility describes how much the perceiver believes someone or something because of what third parties have reported. For instance, if people see assessments made by *Consumer Reports* or receive recommendations from friends, they may tend to rely on them as unbiased views. *Surface* credibility refers to believability based on simple inspection, such as looking at the cover of a book or relying on the type of language people use as an indicator of credibility. *Experienced* credibility refers to believability based on first-hand experience; as people interact over time, their expertise and trustworthiness can be assessed.

For the past decade, the new term *Web credibility* has been increasingly used in a variety of disciplines. Burbules (2001) argued that Web credibility needs to be discussed independently of other types of credibility on the grounds that conventional methods for assessing credibility may not be feasible on the Web because of its speed, complex features and link structure, and lack of referencing and organizational conventions. Danielson (2005) has pointed to four general characteristics that complicate Web users’ credibility assessment strategies: (1) the relative lack of filtering and gatekeeping mechanisms; (2) the form of the medium, including interaction techniques and interface attributes either inherent to the Web and other hypertext systems or emerging from common design practices; (3) a preponderance of source ambiguity and relative lack of source attributions; and (4) the novelty of the Web as a medium in conjunction with a lack of evaluation standards.

Related Concepts

Credibility and Quality

Taylor's (1986) conceptual model of information quality suggests that people make judgments in choosing particular information objects by assigning value to some but not others. To make choices about information, the kinds of questions to be asked include: Is this information error-free? Does this information cover a particular subject or discipline? Is this information recent? Does this information show consistency of quality performance over time? Can this information be judged as sound (Taylor, 1986)? Among these, one critical question to be asked is: "Can I trust this information?" or "Can I take this information seriously?" (as Wilson [1983] might have suggested). The evaluation of these questions often forces an information seeker to step back and evaluate who or what is perceived to be responsible for the information. That is precisely the question of credibility, one of the chief aspects of quality.

Taylor (1986) identified six categories of user criteria for making choices: ease of use, noise reduction, *quality*, adaptability, time saving, and cost saving. He defined quality as "a user criterion which has to do with excellence or in some cases truthfulness in labeling" and identified five values included in quality: accuracy, comprehensiveness, currency, reliability, and validity (p. 62). Although Taylor did not explicitly use the term "credibility," the notion is embedded in his derivation of quality from reliability and validity. These aspects of information quality can be used when people need to make decisions about information; however, such decisions can be difficult because a text may be of high or low quality in many different ways. For instance, a text can be comprehensive but not accurate, have validity but not be current, and so on. Therefore, information seekers sometimes must make choices about which values matter most to them. This is where credibility plays an important role. Out of a set of objects that appear to hold various information values, people tend to choose the items that appear to be most credible. That is, credibility provides one more layer of information evaluation to select items from a pool of documents that are initially judged as being of high quality.

Credibility and Authority

Wilson's (1983) theory of cognitive authority is closely related to the concept of credibility. Both feature trustworthiness and competence as their main components. Wilson argues that what people know of the world, beyond the narrow range of their own lives, is only what others have told them. People do not, however, count all hearsay as equally reliable. Only those who are deemed to "know what they are talking about" are recognized as cognitive authorities. Wilson claims that people do not attribute cognitive authority exclusively to individuals. Cognitive authority is also found in books, instruments, organizations, and institutions. Wilson points out that an authority's influence on us is thought proper because "he is thought credible, worthy of belief" (p. 15). Further, he distinguishes between the average person's competence and the expert's special competence. For instance, people often assume that their friends, neighbors, and colleagues are generally trustworthy and of ordinary competence and so consider them to be credible sources. They may, of course, fail to influence one's thoughts if they are perceived to lack expertise in a particular domain.

However, people also recognize that some sources have more than ordinary competence in particular spheres; these become the cognitive authorities within those spheres. Wilson (1983, p. 16) states that "our cognitive authorities are clearly among those we think credible sources, but we might recognize someone as credible in an area even though he did not in fact have any

influence on our thoughts.” People believed to be credible constitute the potential pool of cognitive authorities upon which to draw. Cognitive authorities are valued not just for their stocks of knowledge (answers to closed questions) but also for their opinions (answers to open questions) as well as for their advice on the proper attitude or stance on questions and their proposed answers. Cognitive authorities are the subset of people or information perceived to be credible. They not only possess competence and trustworthiness but also influence thoughts deeply, as people would consciously recognize as being proper.

Credibility and Trust

It can be difficult to discuss credibility without referring to trust or trusting behaviors and vice versa. Historically, trust has been a core construct in many conceptualizations of credibility (Hovland et al., 1953). Marsh and Dibben (2003) provide a good overview of the theoretical meanings of trust. They argue that trustworthy interfaces become enabling technologies because they lead the user to want to interact with them, thus increasing productivity. This notion of trust has become critical for e-commerce research because consumer trust affects online behavior. The notion of trust in information itself is also critical when one considers content, source, intent, and meaning.

Tseng and Fogg (1999) point out that, although credibility and trust have sometimes been used interchangeably, they should not be considered synonymous. Trust is different from credibility because “trust indicates a positive belief about the perceived reliability of, dependability of, and confidence in a person, object, or process” (p. 41). They suggest that, in the field of HCI, trust refers to dependability and credibility is roughly synonymous with believability. Tseng and Fogg further distinguish between the general concept of trust and “trust in information” (p. 41). Trust is often used with respect to, for example, reliance on a computer system designed to keep track of financial transactions but other uses of the term, including “trust the information,” “accept the advice,” and “believe the output,” are more properly understood as references to credibility (p. 41). Trust frequently refers to a set of beliefs, dispositions, and behaviors associated with the acceptance of risk and vulnerability. Credibility refers to a perceived quality of a source, which may or may not result in associated trusting behaviors.

Credibility and Persuasion

Finally, we need to distinguish between credibility and its most recognizable outcome, persuasion, as operationalized by message acceptance. Aristotle’s discussion of ethos is widely considered to be among the first attempts at conceptualizing what is now more commonly referred to as source credibility; indeed, a short phrase used to refer to the construct—“persuasion through character”—captures a number of underlying assumptions that have long been influential in credibility research. The most obvious of these is that credibility is intimately tied to persuasion, but it was not until the twentieth century that researchers began to test this assumption rigorously (see Pornpitakpan, 2004, for a review) and to identify conditions under which source credibility exerts no effect on persuasion or, paradoxically, decreases the effect. Thus, although source credibility is a critical determinant of message acceptance (Petty & Cacioppo, 1981), the two constructs are not equivalent.

Underlying Dimensions

Researchers, particularly in interpersonal and mass communication, have long understood credibility to be a multidimensional construct (McCroskey & Young, 1981) but have not always agreed on its underlying dimensions. Numerous labels have been suggested and have come to be influential in subsequent research, including trustworthiness, expertise, dynamism, competence, and goodwill. In order to understand the source of this disagreement, we need to understand the limitations of the prevailing approaches used to tease apart the construct's dimensions. Such approaches include two basic activities: the *creation* of candidate terms relevant to credibility and the *validation* of these candidate items, resulting in a reduced set indicative of the construct's primary dimensions. In the creation stage, researchers attempt to generate a list of terms that, at face value, are relevant to credibility. For example, Singletary (1976) and VandenBergh, Soley, and Reid (1981) asked participants in their studies to imagine a specific high-credibility source (in Singletary's case, a news person; in VandenBergh et al.'s, an advertiser) and to list as many terms as possible that, in the participant's view, gave credibility to that source. Other researchers either sampled the existing literature to create a list of candidate terms based upon their review or relied upon intuition. In the validation stage, these candidate terms are summarized and reduced, most often using factor analysis. This basic two-stage approach may in some ways seem reasonable for teasing apart the dimensions of credibility, but it has led to widespread disagreements for many reasons.

Creation methods. The first and most obvious difficulty is in choosing the right approach for generating candidate terms. One's validation stage is only as good as one's creation stage; that is, if creation methods fail to generate a sufficiently broad range of terms or if the set of terms is itself biased in some way, the results of the validation stage will be similarly biased. These methods have, out of necessity, been largely qualitative and sometimes creative endeavors. A number of relevance studies, for example, collected user-based criteria simply by asking users what made them think that the information was useful without developing a predefined set of relevance criteria—an approach similar to that of Singletary (1976) and VandenBergh et al. (1981). The user criteria were derived from content analysis of oral or written reports (Barry, 1994; Cool et al., 1993; Park, 1993; Schamber, 1991; Wang & Soergel, 1998).

Validation methods. One approach for reducing the number of candidate terms has been the use of factor analytic methods. This carries inherent limitations, particularly with respect to the subjectivity of interpreting results (Infante, Parker, Clarke, Wilson, & Nathu, 1983; Meyer, 1988). Indeed, even the labeling of factors is subjective and, consequently, it is often unclear whether dimensions identified by different researchers as representing similar but distinct sets of terms are in fact the same, “expertness” and “competence” being a case in point. Other methodological issues, such as participant response, may be set using semantically different scales and so can influence which dimensions emerge in a given study.

Dimensions versus predictors. Even relatively rigorous creation and validation stages face a fundamental problem: It is often unclear whether the factors identified are mere predictors of source credibility or representative of an underlying dimension of the construct (Newhagen & Nass, 1989). The “face validity” of proposed dimensions is largely subjective; it is debatable, for example, whether one ought to consider dimensions referring to extroversion of a communication source as a mere correlate of source credibility or a distinct dimension (McCroskey & Young, 1981).

Unit of analysis. Finally, it is important to recognize that the *target* of a researcher's interest—be it public speakers, newspapers, or Web sites—likely has a critical impact on the dimensions the researcher uncovers. Newhagen and Nass (1989) have shown that information seekers use different criteria to evaluate newspapers and television and that this can lead to differences in both assessments of those media and in what one concludes to be the important dimensions of credibility.

Thus, the various sets of dimensions reported by different studies simply reflect differing criteria for evaluating vastly different media. It is not surprising, then, that “dynamism” (encompassing such variables as animation and showmanship) was long considered a distinct dimension of credibility when the focus was on platform speakers. That changed as the credibility dimensions of print news began to interest mass communication researchers. Different media variables influence user goals and attention and these, in turn, influence the strategies users employ in making credibility assessments (Austin & Dong, 1994; Danielson, 2005; Mulder, 1980).

The fundamental fact that the underlying criteria used in evaluating credibility can be largely situation-dependent plays an important role in our analysis of multidisciplinary approaches.

Multidimensional Approaches to Credibility

Information Seeking and Retrieval

In information science, assessments of information and sources have often been discussed within the context of relevance judgments. It is often believed that users make decisions to accept or reject information based on whether they judge it to be relevant to their information problem. Relevance has been considered the primary criterion in selecting information (Mizzaro, 1997; Saracevic, 1996); indeed, the term “credibility” did not appear in the literature on information seeking and retrieval until the 1990s (Fritch & Cromwell, 2001; Janes & Rosenfeld, 1996; Wathen & Burkell, 2002; Watson, 1998). It is no coincidence that this topic has steadily gained prominence with the growth of the Web.

Credibility as a Relevance Criterion

In general, information science researchers have considered the assessment of credibility to be a part of relevance judgments. In the 1990s, several empirical studies (Barry, 1994; Cool et al., 1993; Park, 1993; Schamber, 1991; Tang & Solomon, 1998; Wang & Soergel, 1998; Wang & White, 1999) were conducted to identify user-defined relevance criteria. These studies revealed that people use much more diverse criteria than mere topicality for their relevance judgments. Interestingly, user-defined relevance criteria show common characteristics and factors across studies conducted in meteorology, health, and scholarly information (Barry & Schamber, 1998; Wang, 1997). Maglaughlin and Sonnenwald (2002) compared the findings of eleven previous studies on relevance criteria, counting the number of times each criterion was identified. The relevance criteria that consistently and frequently appeared included subject matter/topic, authority, completeness/depth, currency/recency, accuracy/quality, affectiveness, belief, credibility, clarity, and document type.

It should be noted here that information science researchers often use the broader term *quality* to denote the concept of credibility. For instance, Barry (1994) found that academic users

employed criteria pertaining to evaluation of a document's source (i.e., source quality and source reputation/visibility). Wang and Soergel's (1998, p. 120) work revealed the criterion of "expected quality," which is defined as an estimation of the goodness of a document in terms of journal quality and author quality. Schamber (1991) examined user assessments of weather information and identified reliability as a criterion. She understood information to be reliable if "the source could be trusted, believed, or relied upon based on reputation or consistency" (p. 129). The results of relevance criteria research indicate that although the labels applied to categories differ from one research study to another, credibility is a notion underlying various relevance criteria such as expected quality, source quality, authority, and reliability. In both work settings (e.g., Barry and Wang & Soergel) and everyday life (e.g., Schamber), users express concerns about the credibility of the information and its source.

Bateman (1998, 1999) explored information credibility in the context of information seeking. From a survey of more than 200 graduate students, she identified the eleven most important criteria and ran a factor analysis to develop a three-dimensional model of relevance: information quality, information credibility, and information completeness. Together, these three factors explained 48 percent of the respondents' concepts of relevance. The results of Bateman's studies indicate that quality and credibility were very important to her user group. Users wanted information that was not only accurate, credible, well written, focused, understandable, and consistent but also easy to obtain, current, and on their topic.

Credibility Judgments of Information Seekers

Olaisen's (1990) research may have been the first empirical study that explicitly addressed the authority and credibility of electronic information. Based on questionnaires and interviews conducted with employees of Finnish banking companies, Olaisen (p. 113) found that the "knowledgeable person" was the most important source for both daily administrative decisions and strategic long-term decisions; these sources ranked high in credibility, influence, reliability, and relevance. Electronic information was emerging as an important source, scoring highly in relevance, perceived value, accessibility, actual value, flexibility, and browsing possibilities, but low in credibility, form, and user friendliness.

Rieh examined the problems of information quality and authority in Web searching by identifying the factors influencing people's judgments of information (Rieh, 2000, 2002; Rieh & Belkin, 1998, 2000). Using Wilson's (1983) theory of cognitive authority and Taylor's (1986) value-added model, she found that source characteristics were the primary criteria people used when making judgments on information quality. Her subjects mentioned source credibility on two different levels: institutional and individual. The Web users in Rieh's studies paid considerable attention to institutional authority, giving greater credence to academic and governmental institutions. They also took into account the affiliation of the author/creator, assigning higher levels of authority to professional experts such as professors, doctors, and librarians. Rieh's research indicates that the range of evidence people employ in ascribing source authority is much broader in the Web context than in the print realm. Moreover, people depend upon such judgments of source authority and credibility more heavily on the Web than in the print environment.

McKenzie (2003) also used Wilson's theory of cognitive authority to understand the basis upon which an individual decides whether or not a particular information source is authoritative.

Her research examined “discursive action” by analyzing information seekers’ descriptions of the authority of information sources in the context of pregnancy (p. 261). Based on her interviews with nineteen pregnant women, McKenzie found that this subpopulation did not blindly accept “authoritative knowledge” (p. 263). Rather, they used several forms of personal positioning to validate or contest the authority of an information source; they relied on themselves “as cognitive authorities, using their own reasoning, bodies, and experience as evidence against which to test the authority of another source” (pp. 281–282).

Scholars are generally concerned with the quality and authority of Web information based on source characteristics and domain knowledge (e.g., Rieh, 2002; Rieh & Belkin, 1998), but students may have different ways of evaluating information credibility on the Web. As Leckie (1996) has pointed out, a model of “expert researchers” that requires in-depth knowledge of the discipline, awareness of important scholars, and participation in a scholarly communication system, cannot be applied to undergraduate students who possess none of these characteristics. A few empirical studies have explicitly investigated how students address the credibility of information when they are seeking information on the Web.

Liu (2004, p. 1031) operationalized credibility assessment as “a cognitive process by which information is filtered and selected.” His analysis revealed that resonance with one’s beliefs, novelty of information, trustworthiness, and good quality have a positive impact on credibility perception. Liu identified two other types of source credibility—verifiable credibility and cost-effect credibility—that, in addition to the four types of credibility proposed by Tseng and Fogg (1999), play a significant role in shaping student perceptions. He noted that because students may not be well equipped for making credibility assessments (e.g., they may lack familiarity with authors’ affiliations), they tend to look for verifiable sources that confirm their credibility appraisals. In terms of cost-effectiveness, Web-based information that is not free, in that it requires purchase or subscription, tends to be viewed as credible. Liu and Huang (2005) found that undergraduate students relied predominantly on an author’s name/reputation/affiliation as well as Web site reputation for their credibility evaluation. In contrast, graduate students focused more on information accuracy/quality.

Based on her interviews with fifteen first-year undergraduates, Whitmire (2004) examined the relationship between students’ epistemological beliefs and reflective judgments on one hand and how they searched for information in digital environments on the other. She argued that people’s ideas about how to view and construct knowledge come into play when they encounter information in digital environments: They make judgments about the information on the basis of these epistemological beliefs. Whitmire introduced the reflective judgment model to examine how epistemological beliefs affect thinking and reasoning processes. Based on their Measures of Epistemological Reflection (MERs) scores, the fifteen undergraduates were divided into two groups: absolute believers and transitional believers. Absolute believers selected information sources consistent with their own views and rejected those that were not consonant with their points of view. When they encountered conflicting information sources, they asked authority figures such as faculty for help in determining source authority rather than figuring things out on their own. Transitional believers used various criteria to evaluate Web sources, such as examining the URL of a Web site, assessing its author’s institutional affiliation, and looking at the publisher of a print source. These students often felt that including conflicting information in their papers strengthened their academic assignments.

Agosto (2002a, 2002b) investigated how young people make decisions while using the Web. She conducted group interviews with twenty-two ninth- and tenth-grade female students and found that adolescents' evaluation criteria of information sources on the Web differ from those of adults. For instance, her study participants had strong positive responses to both the color and the design of graphics and multimedia. Perceived quality of information content proved to be a primary evaluation criterion, but these users tended simply to equate information quality with information quantity. Credibility and authority were not discussed extensively. Agosto's findings are consistent with those of Fidel, Davies, Douglass, Holder, Hopkins, Kushner, et al. (1999), who also did not find credibility to be a major concern of high school students when they evaluated information encountered on the Web.

In summary, discussions of credibility within the field of information seeking and retrieval have come to prominence only during the past few years. Most studies in this area have sought to understand people's perceptions and judgments of credibility in the Web context. The Web provides a unique information-seeking environment because of its relative lack of quality control mechanisms. Scholars still tend to make use of conventional indicators of credibility (such as an institution's name and an individual's affiliation) within the context of the Web; young adults, who have not yet acquired the knowledge and skills necessary for assessing credibility, give evidence of quite different perceptions about Web information. This problem will be discussed further in the section on Teaching Critical Thinking.

Management Information Systems

In a wide range of organizational settings, managers and other decision makers rely upon general judgment and advice, specific recommendations and solutions, and factual claims presented by information systems. Research in this area has examined (1) when and to what degree users of expert systems, decision support systems, and other information systems may over-rely or under-rely on advice provided by these systems; (2) whether credibility assessments of, and responses to, information system advice might differ from those produced by non-computer sources such as people; and (3) the effects of providing various types of explanations for a system's conclusions or recommendations.

Expertise and Information Systems

There is little evidence that users are generally in awe of computers' decision-making or advisory abilities; nonetheless, they may have high expectations, as the very name of one class of systems—"expert" systems—suggests. As Winograd and Flores (1986, p. 132) point out, "When we talk of a human 'expert' we connote someone whose depth of understanding serves not only to solve specific well-formulated problems, but also to put them into a larger context." Words such as "intelligence," "knowledge," and "understanding" also carry connotations above and beyond expert systems' capabilities and thus may obscure their inherent limitations (Will, 1991; Winograd & Flores, 1986). Unlike human experts, expert systems are often "brittle" in the sense of being unable either to cope with small deviations from their programmed expertise or to apply broader contextual knowledge and common sense to novel situations.

Nevertheless, expert systems are generally viewed as credible advisers in a wide range of domains and circumstances, even though such systems use static information and rules applied to dynamic problems (Murphy & Yetmar, 1996). Dijkstra (1999) has pointed out that, when users

are unable to verify information from such systems, they may rely on peripheral cues, such as the degree to which the interaction with the system is enjoyable, in deciding whether to accept the system's output. This is similar to social interactions, where source credibility is often relied upon in place of a more rigorous examination of claims and arguments (Petty & Cacioppo, 1986).

Several researchers (e.g., Flake, 1991; Lerch, Prietula, & Kulik, 1997; Wærn & Ramberg, 1996) have sought to compare responses to advice derived from expert systems and other information systems to that given by humans. These researchers have found that users perceive human and computer advisers differently but do not always perceive or respond differently to advice from these two sources. Wærn and Ramberg (1996) found no differences between the perception of advice given by computers and by people but did discover evidence that humans and computers may be perceived as more or less trustworthy depending upon the task. Similarly, Dijkstra, Liebrand, and Timminga (1998) found that users perceive expert systems as more objective than humans. Lerch et al. (1997) found that users place greater confidence in human advice than in advice provided by an expert system. However, when particular expert systems were said to perform more reliably than human advisers, participants did agree more with the former in spite of having less confidence in expert systems as a whole. The researchers pointed out that users respond to predictability and dependability separately in making concurrence decisions. Dependability assessments reflect source attributions, whereas predictability assessments are based upon known or perceived behavioral consistency, not source attributions. The researchers also found that users perceive human and expert system advisers differently, attributing effort only to humans and invoking experience as an explanation for expertise only in the case of humans.

The perceived objectivity of expert systems reported by Dijkstra et al. (1998) is consistent with research indicating that users seek out, and respond differently to, human- and computer-based feedback. Kluger and Adler (1993) found people to be more likely to seek feedback from a computer when the goal was to obtain objective information about their performance. Earley (1988) reported that computer-based feedback was considered more credible than the same feedback from human superiors. In spite of these reported differences, Jiang, Klein, and Vedder (2000) found compliance patterns in human-system interactions that were consistent with human-human persuasion contexts. Users are more likely to comply if confidence in the source is high, self-confidence in the decision domain is low, and the discrepancy between the user's initial choice and the system's suggested choice is low. Finally, use of expert systems has the potential to imbue people with increased credibility in subsequent human-human interactions. Murphy and Yetmar (1996) found that managers in public accounting firms agreed more frequently with a subordinate's evaluations if told that the subordinate had used an expert system to reach the decision.

Reliance

Users of information systems often accept a recommended course of action from a system without critical examination or without considering the possibility of system errors. Such errors can result from commission, in which a rule contributing to a system's output is factually incorrect, or omission, in which a rule is missing altogether or is incorrectly constrained (Will, 1991). The limited ability of users of information systems to recognize and account for such inaccuracies is not uncommon, even for human experts in the system domain who are evaluating

weak arguments (Dijkstra, 1995; Kottemann, Davis, & Remus, 1994). Expert system usage can reduce the motivation to think critically about the information upon which a decision is based, with users committing to it based solely on the credibility of the decision support system itself (Landsbergen, Coursey, Loveless, & Shangraw, 1997).

Will (1991) had a group of reservoir petroleum engineers interact with an expert system that suggested erroneous models for solving well pressure buildup problems and noted that both novices and experts relied on the incorrect models. Compared to a group of users who had arrived at incorrect conclusions using *conventional* methods (rather than an expert system), the novice group using an erroneous expert system showed greater confidence in its decisions. Will argued that this provides evidence for over-reliance on the expert system by novices.

Even in the case of critical decisions, users faced with a difficult task requiring the integration of large amounts of information may rely on decision-support systems without attempting to verify their information. Biros, Fields, and Gunsch (2003) found that operators in a military command and control scenario tended not to make use of available external safeguards for verification.

Additionally, Swinney (1999) has found that organizational norms and biases may make some types of system recommendations more acceptable than others, again leading to over-reliance. Conversely, because information systems are often used within organizational settings, factors such as word-of-mouth effects among co-workers or fear of the system's impact on job security can lead to under-reliance or general suspicion. If trust in automation is low, operators may consequently view such systems as less credible and thus reject accurate information (Muir, 1987). Moreover, overconfidence in one's own abilities can lead to under-reliance on a reliable system (Swinney, 1999).

Luthans and Koester (1976) and Koester and Luthans (1979) found evidence that experience may influence one's tendency to accept and comply with suggestions from computers. They found that highly experienced users may be overly skeptical and that inexperienced users tend to over-rely on suggestions from computers, as compared to a control condition with mimeographed lists of the same suggestions. This finding is consistent with an early belief among researchers that users are likely to be "in awe" of computers, viewing them as credible in a wide range of domains (Pancer, George, & Gebotys, 1992); however, subsequent experimental research has shown little evidence for this belief (e.g., Andrews & Gutkin, 1991; Wærn & Ramberg, 1996).

Findings of both over-reliance and under-reliance on information system advice demonstrate that developing an accurate understanding of a system's accuracy over time can be difficult. Even when evidence is considered or system behavior is observed, users may place too much weight on recent outcomes, leading to either over-reliance or under-reliance (Jiang, Muhanna, & Pick, 1996). However, users may be better equipped to detect errors if they are warned about potential data quality concerns prior to interaction with the system (Biros, George, & Zmud, 2002). As Muir (1987) has pointed out, users supported in appropriately calibrating their acceptance of information system advice will be best able to understand the circumstances under which a system's output can be reliable. Muir argues that in order to interact most effectively with such systems, users need an accurate perception of the system's level of trustworthiness (e.g., a lack of unnecessary skepticism or awe) and an understanding of the most effective criteria upon which to base this judgment.

Explanations

Expert and decision support systems are often equipped with explanation facilities that can expose the underlying processes behind system conclusions and recommendations. These explanation facilities may be invoked by the user, remain constantly present, or be presented to the user based on an analysis of user interactions with the system (Gregor & Benbasat, 1999). Explanations provided by these facilities can vary in both referent and form. Trace or line-of-reasoning explanations provide a logic behind the decision; justification or support explanations point to extensive reference material in support of a full or partial decision. Control (or “strategic”) explanations indicate the problem-solving strategy used in arriving at the conclusion. Finally, terminological explanations provide definition information (Gregor & Benbasat, 1999; Ye & Johnson, 1995). Ye and Johnson (1995) found that auditors were more likely to accept expert system advice when the system’s reasoning process was made clear via use of explanations, with justification explanations being the most effective. The researchers noted that different domains of human work have varying standards for what constitutes an acceptable argument.

Each explanation type may also be presented to system users in various ways. Researchers typically distinguish between natural language and production rule presentations; in some cases, the contrast has been characterized more generally by *mechanistic* dialogues versus *humanistic* ones. *Procedural* presentations of facts demonstrate IF-THEN rules, whereas *declarative* presentations simply list the involved facts without demonstrating the necessary procedural rules for arriving at a solution (Lamberti & Wallace, 1990).

Dijkstra et al. (1998) found the perceived objectivity of expert systems to be pronounced when such systems presented arguments using a production rule format. Exposing or increasing the transparency of decision-making processes does not always influence attitudes toward decisions, however, such as in the case of exposing the algorithm behind the process (Brown & Jones, 1998). Lerch et al. (1997) found that although providing explanations increased user agreement when expert system advice was given, it failed to boost user confidence in the system.

It is important to note that user desire for explanations can be driven by discrepancies between expert system advice and initial user choice or attitude. If the discrepancy is very low, the benefit of seeking an explanation may be outweighed by the cost; if the discrepancy is too high, users may see little chance of being persuaded. If users typically choose not to seek system explanations, human–system trust may not develop. Such explanations may be critical not simply for short-term compliance (as is the focus of most studies) but also for appropriately calibrating user reliance on system advice and for increasing domain knowledge, thus reducing the “black box phenomenon” (Landsbergen et al., 1997) in user interactions with complex expert systems.

Consumer Behavior

Consumers have an incentive to look for reliable cues to a product’s level of quality prior to purchase as well as to avoid high costs associated with information seeking. The entities with the greatest amount of accurate information about available products are the firms themselves but they are inherently biased. Because firms and consumers have asymmetric information about the quality of available products, consumers still must incur costs in evaluating claims and assessing the credibility of firms, advertisers, and other marketing sources (Spence, 1974; Stigler, 1961). Information technology can help to reduce these asymmetries, but it also creates

new pressures on credibility evaluation, often compelling consumers to integrate and assess product-relevant messages and interpret firms' overt behaviors in new ways. In this section we review the concepts of claims, verification, and signaling and their relevance to credibility assessment and discuss how the use of information technology can distort, impede, or enhance credibility assessments by consumers.

Claims

One straightforward way in which firms attempt to inform consumers of product quality is through claims made in advertisements and other marketing materials. Consumer researchers have attempted to distinguish between relative levels of objectivity and subjectivity in these claims. *Factual* claims describe objectively verifiable product features such as performance dimensions; *evaluative* claims appeal to subjective and emotional responses to intangible aspects of the product such as prestige of ownership (Holbrook, 1978). Darley and Smith (1993) have separated the two critical dimensions of objectivity (factual/impressionistic and tangible/intangible), pointing out that maximally objective claims will both be factual and refer to tangible attributes but maximally subjective claims will be impressionistic and refer to intangible attributes. Factual claims regarding intangible attributes are argued to be impossible, as is consistent with most conceptualizations of these dimensions (e.g., Ford, Smith, & Swazy, 1990).

The use of exaggerated claims ("puffery"), however, has its limits. Claims may be extreme in either a consumer-independent or consumer-dependent sense. Source credibility is a critical factor moderating the (dis)incentive for firms to overstate product quality. When source credibility is low, moderate claim extremity achieves greatest attitude change and, thus, such firms have no incentive to be deceptive beyond this point (Goldberg & Hartwick, 1990); indeed, it may be most beneficial to understate quality until source credibility is enhanced (Kopalle & Assunção, 2000). When source credibility is high, claim extremity is generally positively related to attitude change (Goldberg & Hartwick, 1990). Even for high-credibility sources, however, claims not relevant to a primary message or central argument within an advertisement can hinder the effectiveness of the message and render it less credible (Mackenzie, 1986; Meyvis & Janiszewski, 2002).

Verification

Probably the most critical aspect of product claims with respect to credibility regards if, when, and at what cost consumers may verify such claims. Nelson (1970, 1974) initially explored the fundamental differences between claims referring to *search qualities* of a product, which can be determined prior to purchase (such as the color of a dress), and *experience qualities*, which cannot be determined until after purchase (such as the taste of canned tuna fish).

The verification of both search and experience quality claims can vary in cost. A home buyer may verify both relatively objective (such as the home's dimensions and amenities) and subjective (such as the home's coziness or the beauty of its surroundings) claims prior to its purchase and still incur the costs of arranging a viewing of the home as well as travel and inspection time. Consequently, subjective claims are again inherently less credible; sellers may exaggerate such claims just enough to entice potential buyers to incur the above costs but not to the degree that discovered exaggeration overwhelms search costs (Nelson, 1974).

Experience quality claims, too, differ in typical verification costs. The price of a good is often an immediate roadblock to verification; an inexpensive good may be tried and discarded if it fails to meet a consumer's needs. Even when price does not significantly hinder "trialability" (Rogers, 1995, p. 243), some product attributes, such as the durability of a running shoe, can be assessed only after a considerable amount of usage (Davis, Kay, & Star, 1991). Darby and Karni (1973) have further distinguished experience qualities that are costly to evaluate from credence; this distinction makes verification costs impossible, for all practical purposes. Consumers may, for example, lack the skills necessary for verification (such as in the case of assessing automobile repair claims). Even in the case of search qualities, complex product attributes may require considerable skill and experience to verify prior to purchase (Shapiro & Spence, 2002). By and large, consumers place a strong belief in their own experiences (Smith, 1993). Wright and Lynch (1995) found direct usage to play a larger role than advertisements in determining belief strength for experience quality claims.

Signaling

Firms often communicate with consumers about the quality of their products and their own characteristics (e.g., reputation and production efficiency) in less explicit ways than through advertising claims, such as by offering warranties and money-back guarantees or simply by the expensive act of advertising itself (Kihlstrom & Riordan, 1984; Nelson, 1974). Credible signals are often those that are expensive to produce, precisely because the expense of the signal can indicate production efficiency and, therefore, product reliability and quality. For a signal to be credible, however, it must also reliably indicate which firms "have the goods" and which do not. If low-quality firms have both the ability and incentive to mimic or fake the signal, then a pooling equilibrium occurs and consumers will be unable to determine which firms are of high quality, thereby reducing the usefulness of the signal. When high-quality firms have an incentive to produce a particular signal and low-quality firms have an incentive to refrain from doing so, a separating equilibrium occurs (Kirmani & Rao, 2000). Warranties, for example, signal quality only under circumstances in which they will be invoked by consumers with sufficient frequency to produce costs for low-quality firms outweighing the benefits (to those same firms) of a noisy market; consequently, they must be observably enforceable (Kirmani & Rao, 2000).

Firms may incur the cost of a signal prior to production and display (such as in the case of advertisements) or they may attempt to signal quality with the understanding that deceptive signals would lead them to incur future costs (such as in the case of warranties and money-back guarantees). For instance, sale signs can credibly signal below-market prices only when a retailer does not overuse them; if too many products are claimed to be on sale or if retailers attempt to introduce noise by placing sale signs on higher-priced items, consumers will become skeptical of the signal and cease to rely on it (Anderson & Simester, 1998, 2001). Notice, however, that credibility decisions based on the use (or overuse) of sale signs are enhanced by consumers' global view of brick-and-mortar stores as well as the impracticality of retailers dynamically and rapidly altering which products display these signals. Thus, a key aspect of in-store browsing and shopping is that consumers gain a view of the "lay of the land" for a set of products associated with a single retailer. Electronic contexts typically hide or distort this "shelved" view of the world, and often aggregate or filter sets of products from various sources.

Online Consumer Behavior

Products presented and described through information technology lack the abundance of sensory data normally available to in-store consumers. Consequently, product qualities normally verifiable prior to in-store purchase become experience qualities for online consumers: This tends to erode the credibility of the Internet as a medium (Graefe, 2003). In few arenas is the link between credibility and subsequent trusting behaviors as immediate as in e-commerce; thus, there is likely to be a strong incentive for firms to leverage digital product experience to increase believability of experience quality claims along with a strong incentive for online consumers to verify such claims.

There are a few primary mechanisms through which these needs are partially addressed. First, online product information can be both abundant and available for processing at the consumer's pace. Such abundant information, however, can come with significant search costs, particularly for novice Internet users who must possess numerous information-gathering skills (Burbules, 2001). Because the amount of successful information gathering is heavily dependent upon user skills and motivation, the extent of reliance on source credibility and brand reputation can differ among consumers (Ward & Lee, 2000). It is well established that the elaboration of claims and importance of source credibility can differ for print, radio, and television ads (Brown, Homer, & Inman, 1998; Smith & Buchholz, 1991), as different media place varying demands on consumer attention and allow for varying amounts of reflection, claim and counterargument rehearsal, and cognitive elaboration.

Second, information technology produces massive electronic "word-of-mouth" networks that consumers might access in order to indirectly assess experience quality claims prior to purchase. Recommender systems assist and augment this process by providing appropriate recipients with recommendations from previous consumers (Resnick & Varian, 1997). Bickart and Schindler (2001) have demonstrated that users gathering product information from online forums tend to have greater product interest than those gathering information from marketing materials available from a corporate Web site. Both recommender systems and online forums carry the advantages of written text over typical spoken word-of-mouth because users may access others' stories and experiences at their own pace and depth (Bickart & Schindler, 2001).

Third, although experience qualities may sometimes drift to search qualities, Klein (1998, 2003) has demonstrated that information systems allow the reverse to occur as well. For example, a consumer might digitally observe how drapes or a vase could be situated in the home—and thus what is normally an experience quality (the attractiveness of the drapes *in context*) becomes an attribute one can examine prior to purchase. More commonly, consumer use of information technology reduces search quality verification costs. Where a consumer would once have been required to travel to a retail store in order to observe many prepurchase product features (particularly the less tangible of these), digital experiences allow for more of these features to be assessed remotely. Daugherty, Li, and Biocca (2001) found that increased levels of telepresence influenced attitude toward the brand. Presence was investigated by varying user control over the environment and the mediated sense of the environment through sensory channels (see Steuer [1992] for an overview of the construct). Klein (2003) similarly found that telepresence increases the strength of beliefs and attitudes for digital product experiences.

Biswas and Biswas (2004) have found that the online shopping context places a premium on credible product quality signals in comparison to in-store contexts. They point out that, compared with in-store contexts, consumers in electronic spaces accept inherently greater risk

and thus have a strong incentive to look for the expensive signals of product quality. This increased risk is a fundamental pressure on credibility evaluations in electronic spaces. When consumers face uncertainty, they tend to rely more heavily on brand reputation (Erdem & Swait, 2004) as a general signal of product quality and without incurring search costs (Adaval, 2003; Anand & Shachar, 2004).

Consumers may frequently rely on the perceived cost of an advertisement as a signal of product quality (Kihlstrom & Riordan, 1984) but the kinds of knowledge used to make such judgments for traditional print and television advertisements (e.g., “popular programs charge more for ad time”) will not always apply in electronic contexts. Moreover, it may be unclear to consumers precisely what makes it costly to produce and display an online advertisement. One cue consumers do appear to use is the quality and credibility of the Web site in which the advertisement appears, which can increase the credibility of the advertisement (Choi & Rifon, 2002). With the newer online medium, however, consumers are likely to face a number of situations in which costly signals (indeed, even those that would normally create a separating equilibrium) will go unnoticed due to the inability to recognize that the signal reliably indicates quality. In these cases, high-quality firms may need to invest resources in demonstrating as well as reminding consumers of the costliness of the signal (Kirmani & Rao, 2000).

On the other hand, in-store consumers have already incurred travel costs; comparative information is more useful when gathered prior to incurring search costs, for example when reading a comparative advertisement at home. In a store, consumers are more receptive to information confirming the fact of a “good deal” and are thereby likely to accept information promoting a preexisting intention to buy (Grewal, Marmorstein, & Sharma, 1996), consistent with cognitive dissonance theory (Festinger, 1957). The accessibility of online information allows such comparisons to be made prior to incurring travel costs and consequently may contribute to greater skepticism toward in-store claims, promoting comparative shopping.

Persuasiveness

A key aspect of consumer credibility assessments of product claims and signals is that buyers and sellers (or advertisers) interact in a context in which persuasion goals are highly salient. Consumers develop knowledge about the sorts of tactics that agents of persuasion typically use as well as beliefs about the fairness or manipulateness of such tactics. This knowledge and set of beliefs in turn shapes how they respond to persuasive tactics (Friestad & Wright, 1994). Further, these tactics may begin to take on a meaning for consumers. That is, they may come to believe that certain tactics reliably indicate something about the communicator (e.g., “If a candidate starts mudslinging, he must know he’s probably going to lose the election”). Moreover, when persuasion goals are salient and consumers have gained experience in such contexts, consumers can more easily step beyond proximate sources and think about the goals and biases of the organizations that serve as puppet masters behind the exchange (Friestad & Wright, 1994). This is in contrast to the vast majority of media experiences in which the motivation to think beyond the proximate source does not exist (Reeves & Nass, 1996; Sundar & Nass, 2000).

Consequently, high source credibility in consumer behavior contexts can in some cases exert little or no effect, or even, potentially, decrease persuasion. When consumers reflect upon their own purchase behaviors to help them develop attitudes toward products and brands, for example, the use of highly credible sources in the brand’s marketing mix can be a liability

because consumers may attribute such behaviors to the advertising tactics rather than attributing it to their own internal motivations (Dholakia & Sternthal, 1977).

Consumer researchers have further noted an inherent trade-off in many cases between increased source credibility and persuasiveness. Including negative claims about a product may indicate lack of bias and increase credibility, for example, but at the cost of consumer intent to purchase the product (Settle & Golden, 1974). It is noteworthy here that high source credibility can in some cases undermine behavioral persistence (Dholakia & Sternthal, 1977). Appeals to source credibility involve the peripheral rather than the central route to persuasion, resulting in attitudes both more predictive of behavior and more resistant to change (Petty & Cacioppo, 1986). Thus, there is potentially a trade-off that firms face in relying too heavily upon peripheral cues in their marketing mix when consumer motivation might in some cases warrant a central route approach with its associated persuasive advantages.

Perhaps the most critical area for research at the intersection of credibility, consumer behavior, and information technology involves how the inherent risk imposed by electronic information spaces influences responses to peripheral cues such as source credibility and potentially unreliable signals of product quality. Such uncertain circumstances create two competing incentives for information seekers: to look for, and rely upon, signals that reduce the inherently high cost of uncertainty while being simultaneously skeptical of such signals due to a lack of clear pressures that would normally ensure their reliability.

Health Science

In the previous sections, we discussed three major strands of theory and research concerning credibility assessment by users of information systems. In each circumstance—evaluating the results of information seeking and retrieval, interacting with systems designed to enhance decision making, and assessing claims and signals regarding products and services—the *importance* of the information being gathered and used has been a critical determinant of how users assess credibility, as predicted by the elaboration likelihood model (Petty & Cacioppo, 1986). For professionals and information seekers alike, the potentially negative effects of inaccurate health information have undoubtedly contributed to the special attention being paid to credibility assessment within the health domain.

Information Systems and Health Professionals

As health professionals' use of information systems increases, so does the need to promote the skills necessary for gathering accurate information efficiently. There is a growing need for producing graduates capable of using information technology to improve patient care (Casebeer, Bennett, Kristofco, Carillo, & Centor, 2002). Casebeer et al. (2002) collected survey data from a sample of 2,200 U.S. physicians and found that online information is used most frequently for addressing novel patient-specific problems. Practitioners are aware of credibility concerns and recognize the need for caution in relying on information systems in patient care (Parekh, Nazarian, & Lim, 2004); however, physicians' information seeking, when compared to that of medical information experts, did not produce the highest quality health information (Groot, ter Riet, Khan, & Misso, 2001). Physicians need to learn new evaluative skills because assessing the credibility of decision support systems and Internet resources is a fundamentally different activity from assessing the credibility of professors, colleagues, and textbooks.

Using online databases frequently may require health professionals to examine unfamiliar sources critically. Nevertheless, problems of credibility assessment remain even when the network of systems used is constrained, either to a set of trusted partners or within a single organization. Systems developed to advise in patient care or assist in diagnosis involve risks resulting from both system design and organizational constraints. Edwards, Kang, Preston, and Compton (1995) claim, for example, that indicating the accuracy of an expert system or its level of agreement with human experts can be misleading because expert system errors in health care decisions may have more disastrous consequences than human errors.

The ability of information systems to assist health professionals accurately is not always built-in and static but rather depends crucially upon organizational commitments and ease of use. The difficulty of entering patient records, case histories, cautionary notes, and other practitioner data into a database can negatively affect the timeliness, accuracy, and effectiveness of the system. Gardner and Lundsgaarde (1994) surveyed physicians and nurses regarding a centralized database intended to integrate information throughout one hospital and found a common concern among nurses about the completeness of database records and the inability to enter complete medical data.

As in managerial decision-making contexts, there has been a concern about the possibility of over-reliance on expert system conclusions. The system investigated by Gardner and Lundsgaarde (1994)—the Health Evaluation through Logical Processing (HELP) system—consisted of an inference engine that could warn of drug contraindications. Over-reliance on this system, based on the presumption that HELP will always indicate contraindications successfully, when conjoined with incomplete medical records, might well prove disastrous.

Further evidence suggests that, within the health sciences, computer output is not perceived to be more credible than human communications. Honaker, Hector, and Harrell (1986) asked a group of clinicians and graduate students in psychology to evaluate personality reports labeled as being generated either by computer or by a human practitioner. They found no evidence that either group perceived reports generated by computers to be more credible than those by people. The clinicians in the sample perceived the computer-generated reports to be less comprehensive.

Online Health Information

According to the Pew Internet & American Life Project (Fox, 2005), 79 percent of Internet users have searched online for information on at least one major health topic. Internet health information is used particularly frequently by younger people (Gray, Klein, Noyce, Sesselberg, & Cantrill, 2005; Licciardone, Smith-Barbaro, & Coleridge, 2001) and women (Baker, Wagner, Singer, & Bundorf, 2003; Escoffery, Miner, Adame, Butler, McCormick, & Mendell, 2005). There are at least two significant issues regarding the credibility of online health information from the consumer's point of view: One has to do with the quality of online health information and the other with the consumer's ability to understand the information.

There seems to be a consensus that the quality of online health information varies. Members of the general public are not simply consumers of health information but sometimes (unqualified) producers as well (Hardey, 2001). These difficulties result in widely varying strategies among consumers for evaluating online health information. For example, Peterson, Aslani, and Williams (2003) found that consumers differed greatly as to which sources they considered most credible when searching for online information about various medicines. Eastin

(2001) found that college students are very concerned about the credibility of health information, paying attention to both source expertise and content knowledge.

There has been much discussion as to what constitutes quality and credibility with respect to health information. Accuracy seems to be widely used as a primary facet of information quality (e.g., Berland, Elliott, Morales, Algazy, Kravitz, Broder, et al., 2001; Fallis & Frické, 2002; Haddow, 2003). When Eysenbach, Powell, Kuss, and Sa (2002) conducted a systematic analysis of 170 health information articles, they found that the quality criteria used to evaluate Web sites were much more diverse: technical quality, design, readability, accuracy, completeness/comprehensiveness/coverage/scope. Most technical criteria identified were “transparency criteria” from the print world: references, disclosure of authorship, author’s credentials, and date of creation (p. 2694).

The Internet may be perceived as a major source of low-quality information but Eysenbach et al. (2002) pointed out that inaccurate information was not a problem specific to the Web; they cited findings from other studies in which 76 percent of the information about oral hygiene from television, 53 percent from magazines, and 12 percent from newspapers was in fact inaccurate. They also reported that the inaccuracy rates of information about healthy eating in printed sources were high: 55 percent in free advertising newspapers, 30 percent in general interest magazines, 17 percent in health magazines, and 14 percent in newspapers. This indicates that the problem of credibility assessment of health information is not limited to the Internet; it is also present in other media.

When comparing the credibility of the Web with other kinds of information sources, Marton (2003) found that women perceived health care practitioners to be the most reliable source. Books were rated second-highest, followed by pamphlets and fact sheets. The lowest-rated information sources were Web-based bulletin boards and chat rooms. Web sites received slightly higher ratings than libraries.

It is important to note that people’s credibility perceptions and actual judgments and behaviors are not always consistent. Eysenbach and Köhler (2002) compared the criteria identified in focus groups and in-depth interviews to the actual search behavior observed in information retrieval experiments. The kinds of criteria participants mentioned that they would use for assessing the credibility of health information on the Internet were diverse: authority of source, layout and appearance, readability, picture of the site owner, credentials and qualifications, content updating, and quality-seal and third-party endorsements. Contrary to the statements made in focus groups and interviews, none of the participants actively searched for information as to who stood behind the sites or how the information had been compiled. Most participants started their searches using general search engines, although only 20 percent were able to report the source name. Another 23 percent could recall the kinds of organizations (government agency, commercial organization, university, etc.). The results of Eysenbach and Köhler’s research indicate that health consumers assess information in a manner different from that implicitly assumed in many studies about information quality and credibility on the Web.

Another important issue is consumers’ lack of skills in evaluating the accuracy of online health information and their reliance on indirect cues (Eysenbach & Köhler, 2002; Freeman & Spyridakis, 2004). Using the term “context deficit,” Eysenbach and Diepgen (1998, p. 1498) listed a number of ways in which health information users can be misled by information on the Web. One example is the difficulty of recognizing whether a document is directed at

professionals or for patients. Patients who read materials intended for health professionals may misinterpret information and thus develop false expectations about treatment options. Again, health consumers may not realize that health information valid in a specific health care context may prove invalid in another.

The criticality of health information increases the importance of examining the information providers, owning organizations, and partnering organizations (Luo & Najdawi, 2004) as well as any related commercial interests (Morahan-Martin, 2004). Such interests are not always disclosed, however, and may be difficult for people to grasp when evaluating online health sites. Eysenbach and Diepgen (1998) propose two kinds of metadata to be assigned to online health information: metadata to help consumers assess reliability and descriptive metadata to provide context.

Online health information consumers simultaneously face difficulty in evaluating information and risk in making decisions based on this information. Possibly as a consequence, online information seeking in the health domain is often accompanied by related offline information seeking. Consumers of online health information may, for example, be influenced by offline interactions in a doctor's office in which specific Web sites might be recommended or advertised (Quintana, Feightner, Wathen, Sangster, & Marshall, 2001).

Gray et al. (2005) discovered that adolescents compared health information found online with information from offline personal sources; conversely, they used the Internet as a verification tool. This contrasts with the rarity of verification behaviors for other information topics; Metzger, Flanagin, and Zwarun (2003), for example, found that college students tended not to verify information found online. This interplay between online and offline information seeking for health information is potentially beneficial, particularly when patients discuss what they find on the Web with health professionals who are able to verify advice as well as dispel myths and clarify misconceptions resulting from inaccurate Internet resources (Benotsch, Kalichman, & Weinhardt, 2004).

Consumers may compare health information gathered online with that from other sources; in such searches, the Internet offers the advantages of privacy and anonymity. For example, on the Internet, people can gather information on topics that they may well feel uncomfortable discussing.

Evaluation of Web Resources

A substantial body of literature has addressed the issue of credibility on the Web, but it is often unclear what the objects of assessment were. There appear to be three distinct levels of credibility assessment on the Web: evaluation of the Web, evaluation of Web sites, and evaluation of Web information. First, credibility assessment can be measured at the media level by comparing the credibility of the Web with other communication means such as television or newspapers. Credibility can be also measured by assessing individual Web sites as sources or by assessing information available on the Web.

Evaluation of the Web

Credibility assessment of the Web at the media level is frequently examined by directly inquiring of study participants if they perceive that the Web as a whole provides credible information resources. Several large-scale surveys of Internet use have included questions about Web credibility. The Oxford Internet Institute surveyed 2,190 households in Britain in 2005 and

found that nearly half (48 percent) believe that most Web information is reliable and only 10 percent believed that just a small portion of the information was reliable (Dutton, Gennaro, & Hargrave, 2005). The Annenberg School Center for the Digital Future (2004) reported that 55.2 percent of its 2003 survey respondents considered the Internet to be a very important or extremely important source of information, a figure that had fallen from 67.9 percent in 2000. The Center for the Digital Future longitudinal studies also indicated a slight decline in the number of users who believed that most or all of the information on the Internet was reliable and accurate (50.1 percent in 2003; 53 percent in 2002; 58 percent in 2001; 55 percent in 2000). The Pew Internet report on search engine users indicated that 68 percent of those surveyed said that search engines were a fair and unbiased source of information and only 19 percent said that they did not have that level of trust in search engines (Fallows, 2005). Interestingly, the 68 percent who considered search engines to be fair and unbiased were less knowledgeable, engaged, and experienced in searching than the 19 percent who were more skeptical.

A number of studies have compared people's perceptions of the credibility of information on the Web with their perceptions of the same when sourced from other media. Research on the credibility of traditional versus Internet information resources has failed to produce consistent findings (Flanagin & Metzger, 2000). Johnson and Kaye (1998) surveyed politically interested Web users and reported that online newspapers and political issue-oriented Web sites were rated as more believable than their traditional counterparts. By way of contrast, Mashek, McGill, and Powell (1997) found that users rated traditional media as less biased than their Internet equivalents when searching for political information. Johnson and Kaye (2002) conducted an online survey on the 2000 presidential campaign and found that online newspapers and newsmagazines were considered to be highly credible sources.

Sundar (1999) investigated the credibility criteria college students used by asking them to read and rate both print and online news stories. Factor analysis of the students' ratings revealed three measures that affected their perceptions of credibility: bias, fairness, and objectivity. A related factor was quality, which was found to be composed of the following measures: accuracy, believability, clarity, coherency, comprehensiveness, conciseness, and whether the stories were well written. Sundar argued that the results revealed a similarity between the factor structures underlying readers' perceptions of the credibility of print news and those underlying readers' perceptions of the credibility of online news.

A potential explanation for these inconsistencies may be found in the experience and confidence levels of Internet users. Flanagin and Metzger (2000) suggested that, as people become more experienced with the Internet, they become increasingly knowledgeable about sites to be trusted and sites to be ignored. Further, more experienced Internet users are more likely to verify Internet information and to judge it credible. This finding is consistent with the Annenberg School Center for the Digital Future's finding that, in 2003, 83.5 percent of very experienced users believed that most or all of the information on news pages posted by established media was reliable and accurate; only 49.1 percent of new users gave the same response. Graham and Metaxas (2003), however, found that college students' confidence in their ability to search the Internet did not significantly affect their performance. The relationship of the level of confidence and critical thinking to search performance certainly warrants further investigation.

These studies compared news in print media and on the Web; Mehta (2000), on the other hand, examined differences between the Web and traditional printed sources within the context

of scholarly research. She investigated authors' citation behavior, noting whether authors cited Web information sources in their published work and what types of Web sources they cited. Some 47 percent of authors' citations came from the .com domain, followed by 22 percent from the .edu domain, and 14 percent from the .org domain. This result seems to contradict the findings of Treise, Walsh-Childers, Weigold, and Friedman (2003) that sites in the .gov domain were perceived to be more credible than those in the .com domain within the context of scientific research. Apparently, as Flanagin and Metzger (2000) have pointed out, people's perceptions about the credibility of different media vary depending on the type of information being sought and on the context in which the information will be used (e.g., news, reference, entertainment, or commercial).

Evaluation of Web Sites

The issue of credibility has been investigated most thoroughly at this level of analysis. Here, the individual Web site has been viewed as the source; credibility in this context is often referred to as Web site credibility. Flanagin and Metzger (2003) conceptualized users' perceptions of credibility along three dimensions: (1) message credibility (i.e., the perceived credibility of the information residing on a Web site); (2) sponsor credibility (i.e., the perceived credibility of the individual whose site is represented); and (3) site credibility (i.e., the perceived credibility of the Web site as a whole).

Abels, White, and Hahn (1997) collected data from faculty members by asking them to engage in "brainwriting" during a focus group conducted in an electronic environment. The six clusters that reportedly influenced the use of Web sites were appearance, content, linkage, special features, structure, and use. These authors noted that "when a user states that information must be useful, they are referring not only to topic coverage but also to the source or producer of the information" (Abels, White, & Hahn, 1998, p. 42).

Fogg and other members of the Stanford Web Credibility Research project have conducted a number of studies on Web site credibility issues (Fogg, Marshall, Kameda, Solomon, Rangnekar, Boyd, et al., 2001; Fogg, Marshall, Laraki, Osipovich, Varma, Fang, et al., 2001; Fogg, Marshall, Osipovich, Varma, Laraki, Fang, et al., 2000; Fogg, Soohoo, Danielson, Marable, Stanford, & Tauber, 2003; Fogg & Tseng, 1999). By conducting an online survey, Fogg and his colleagues examined which elements boost and which hurt perceptions of Web credibility. In their first study, conducted in 1999, Fogg, Marshall, Laraki, et al. (2001) collected data from more than 1,400 participants based on seven composite scales of characteristics of Web sites. The results showed that five types of elements increased credibility perceptions (real-world feel, ease of use, expertise, trustworthiness, and tailoring), but two types of elements decreased credibility perceptions (commercial implications and amateurism). In another study, Fogg et al. (2003) asked more than 2,600 participants to compare and comment on two Web sites within a particular content category (e.g., e-commerce sites, news sites, nonprofit organizational sites, travel sites, Web search sites). They selected ten Web sites within each of ten content categories and analyzed participants' comments to ascertain which Web site features were noticed when people evaluated credibility. Their research identified a number of features including design look, information design/structure, information focus, company motive, usefulness of information, accuracy of information, name recognition and reputation, advertising, bias of information, and tone of writing. Of the top ten issues about which participants were concerned, five dealt with information, three with design issues, and two with source

characteristics. These results were compared with the credibility assessments of fifteen experts in the health and finance fields (Stanford, Tauber, Fogg, & Marable, 2002). Overall, domain experts were considerably less concerned about visual appeal than were consumers; they also expressed more concern about the quality of a site's information. Stanford et al.'s study found that health experts assigned more credibility to health sites that provided information from reputable sources and relied on author credentials. Finance experts assigned more credibility to finance sites that provided unbiased educational information rather than steering consumers toward their own products and services.

Based on four years of quantitative research on Web credibility, Fogg (2003b) developed the prominence-interpretation theory, which posits two aspects of credibility assessment: the likelihood of an element related to the source or message being noticed when people evaluate credibility (prominence) and the value or meaning assigned to the element based on the user's judgment of how the element affects the likelihood of being good or bad (interpretation). Fogg identified five factors affecting prominence: user involvement, information topic, task, experience level, and other individual differences. Three factors affecting interpretation were identified: user assumptions, user skill and knowledge, and contextual factors such as the environment in which the assessment is made. Fogg explained how people repeated their evaluative processes, focusing on different Web site elements until they were satisfied with their credibility assessments or until other constraints, such as lack of time or skill, stopped them.

Young adults might have ways of assessing credibility on the Web that differ from what adult Web users do. Clark and Slotta (2000) explored the topic of how inclusion of static images with written text on the Web influenced high school students' interpretations of source authority. Although students could reliably judge the higher authority sources as being more knowledgeable and trustworthy than lower authority ones, no significant difference was revealed in students' final preference for either type of information source. Furthermore, boys tended to rate a piece of evidence as more important when it included an image, but girls believed information presented as text-only to be more important.

Wathen and Burkell (2002) have conceptualized the evaluation process of Web sites on three levels: surface credibility, message credibility, and content evaluation. In surface credibility assessments, users focus on presentational and organizational characteristics of a Web site. In message credibility assessments, users thoroughly review indicators of source and message credibility and decide whether the information provided is likely to be believable. In content assessments, users integrate source evaluations with self-knowledge of their own expertise, domain knowledge, and information need, deciding if and how to act on the information. If failure occurs at either the surface or message credibility assessment stages, the user is likely to exit the site.

Tombros, Ruthven, and Jose (2005) investigated the criteria used by Web searchers in assessing Web pages. They separated these criteria into six categories: text, structure, quality, non-textual items, physical properties, and counted mentions of page features. Each category contained several kinds of document features. For instance, the "quality" category included scope/depth, authority/source, recency, general quality, content novelty, and error on page. The component features of "text" were content, titles/headings, query terms, and numbers. The authors reported the ranking of the ten most important features users took into account when judging a Web page to be useful and the ten they took into account when judging a Web page not

to be useful. Most features mentioned for one type of judgment were mentioned for the other type as well, but authority/source was listed as an important indicator only of usefulness.

Hong (2006) examined the influence of both message and structural features on perceptions of Web site credibility as measured by five dimensions of credibility: expertise, goodwill, trustworthiness, depth, and fairness. Message features refer to the characteristics of a message that lend perceived credibility to the overall message of the source. The interactive nature of Web sites is such that the relative contribution of structural features to overall site credibility should be assessed separately. Regression analyses indicated that message features were more important than structural features in determining perceived site credibility. The presence of quotations/testimonials, statistics, authorship, source reference, information currency, and information selection criteria in Web sites was positively associated with site credibility. In contrast, structural features such as the presence of third-party endorsements, privacy policy, site authorship, site contact information, and site navigation tools did not influence perceptions of Web site credibility.

Evaluation of Web Information

This level explores the concept of credibility on the basis of individual objects of information found on the Web. For instance, when people come upon a new fact or obtain information from the Web, can they trust what they have found? The assumption is that the credibility of information can vary on the Web and even within the same site. There are two approaches to this issue, the first being to provide guidelines on the criteria that could influence users' perceptions of the quality of information they obtain. This is discussed in the next section on Teaching Critical Thinking. The second approach is to understand users' assessments based on their own statements. This method is similar to that of relevance criteria studies except that the focus is on assessments of credibility rather than on judgments of relevance.

Rieh (2000, 2002) examined the factors influencing judgments of information quality and cognitive authority by collecting users' verbal reports through think-aloud sessions and interviews. The content analysis of the criteria mentioned by Web users resulted in six major categories with fourteen subcategories as follows:

<begin numbered list>

1. Characteristics of information objects (type of information object, title, content, organization/structure, presentation, graphics, functionality)
2. Characteristics of sources (URL domain type, type of source, source reputation, single versus collective source, author/creator credentials)
3. Knowledge (domain knowledge, system knowledge)
4. Situation
5. Ranking in search output
6. General assumptions

<end numbered list>

Rieh's (2000, 2002) results showed that when people made choices about which Web page to visit first (predictive judgment), they relied on their previous knowledge. For instance, the study subjects went directly to sites recommended to them by other people or to sites they already knew. When people evaluated Web sites during use, prior knowledge became a less important factor as they paid more attention to the characteristics of information objects, especially content, graphics, organization/structure, and type of information object. Interestingly,

the characteristics of sources—source reputation, type of source, and author/creator credentials—were consistently important for users making both predictive and evaluative judgments. Huerta's (2003) findings confirm Rieh's research by determining that out of five manipulated variables (quality of content, modality of exposure, simulation, message attractiveness, and reputation of the Web site owner), quality of content and owner reputation were statistically significant.

Addressing the issue of credibility by distinguishing among the three levels of evaluation of the Web, evaluation of sites, and evaluation of information clarifies some of the conflicting results and arguments. Overall, the Web itself seems to have gained a certain level of credibility as an information source over the years, comparing favorably in terms of credibility with traditional media such as television, newspapers, and magazines (Annenberg School Center for the Digital Future, 2004). In many studies, credibility has been operationalized in terms of reliability and accuracy. As these studies dealt with two aspects of credibility in one question (is the information reliable and accurate?), it remains unclear what respondents actually meant when they answered the question. They might have thought that the information on CNN.com is more accurate than that broadcast by CNN television simply because the Web tends to be updated more frequently.

Applications of the Concept of Credibility

Applying the concept of credibility to information systems can be done in three ways. Perhaps the most widely discussed application area is how to teach people to evaluate information so that they obtain it from credible sources: Two approaches are the checklist model and the critical thinking model. Second, the evaluation criteria that people are advised to use can also be employed as guidelines by Web designers who want to boost a site's credibility. The third area concerns designing information retrieval systems in which various aspects of credibility judgments can be integrated with topical relevance to improve search performance. Evaluating information credibility and designing credible systems and Web sites are two sides of the same coin. Together, they help people secure good, useful, reliable, and trustworthy information to help them with the task at hand.

Teaching Critical Thinking

Much of the literature on the instruction of information evaluation aims to teach students by addressing issues such as how to make a quality assessment when potentially relevant materials have been located (Cooke, 1999). The criteria proposed tend to be drawn from librarians' experience of selecting materials for their collections. The items suggested in the various checklists can be summarized as follows (Alexander & Tate, 1999; Cooke, 1999; Dragulanescu, 2002; Kapoun, 1998; Kjartansdóttir & Widenius, 1995; Pratt, Flannery, & Perkins, 1996; Tate & Alexander, 1996):

<begin bulleted list>

- Objectivity issues: Is there a statement of the aims, objectives, and intended coverage? Is the information presented with a minimum of bias? To what extent is the information attempting to sway the opinion of the audience?
- Source reputation issues: What are the reputation and experience of the author or institution responsible for the information? Is the information written by a subject expert or produced by an institution with recognized knowledge and expertise in the field?

- URL domain issues: Is the document from a government site (.gov), educational institution (.edu), commercial site (.com), or nonprofit group (.org)?
 - Currency and maintenance issues: Does the site indicate the date information was posted? Is the information up-to-date? Is the site generally well maintained?
 - Information accuracy issues: Is the information factually accurate? Are there any typographic, spelling, or grammatical errors? Is it an advocacy site, championing the viewpoint of a particular organization? Is the information based on research or other evidence? Are there any references to published sources of information?
 - Presentation of information issues: Is the information clearly presented and arranged? Is there a site map? Is there a search facility? Is the information categorized and has it been appropriately organized? Are the individual pages aesthetically pleasing? Is the text easy to read? Is it well written?
 - Accessibility issues: Is the source reliably accessible? Can the source be accessed quickly? Is any additional software or hardware required? Are there any access restrictions, such as registration, passwords, proof of eligibility, or membership in an organization?
- <end bulleted list>

This checklist model has some limitations because evaluation of information is, for the most part, subjective, relative, and situational rather than objective, absolute, and universally recognizable (Rieh, 2000, 2002). Individual users have different expectations, make different predictions, and, more importantly, possess different levels of knowledge. Therefore, credibility is not always determined by the characteristics of information objects and sources, although these characteristics do serve as the bases for such judgments. Given the subjective nature of credibility judgments, bibliographic instruction needs to focus on helping students make informed judgments about others' knowledge claims (Wilson, 1991).

Meola (2004) offers a contextual approach to Web site evaluation as an alternative to the checklist model. The contextual approach uses three techniques: promoting the library's subscription-based electronic resources, comparative thinking and analysis, and corroboration (i.e., having students verify information against one or more different sources). Arnold and Jayne (1998) have also emphasized that the Web needs to be presented not as a tool, but as another information resource in the context of the information-seeking process. Students need to learn how to locate, evaluate, and use information effectively on the Web. This is an issue of information literacy (Buschman & Warner, 2005).

Information literacy and critical thinking are closely linked. McGuigan (2001) has pointed out that critical thinking and information literacy share the same goals: engaging students to be proactive learners who can use critical thinking skills in locating and using information. The Association of College and Research Libraries (2004) included in its definition of an information-literate individual the ability to evaluate information and its sources critically. Critical thinking is often considered as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered ... as a guide to belief and action" (Scriven & Paul, 2004, online). Case (2003) has proposed a range of tools that students need for critical thinking, such as background knowledge, critical thinking vocabulary, thinking strategies, and habits of mind that include open-mindedness, tolerance for ambiguity, an inquiring or critical attitude, and an intellectual work ethic.

Authors of library instruction and critical thinking literature point out the limitations of the simplistic approach of using a checklist with evaluation criteria. Critical thinking studies tend to be case studies of library instruction programs and thus are not value-neutral (Buschman & Warner, 2005; D'Angelo, 2001; Morrison & Stein, 1999; Swanson, 2004). More importantly, what seems to be missing in the current literature is the interventionist role that information professionals and librarians can play in facilitating people's judgments about the credibility of information.

Designing Web Sites

Teaching people how to evaluate information is not the only way with which information professionals can address the problem of information credibility (Fallis, 2004). Another is to help users make credibility judgments by highlighting evidence of credibility in information systems and Web sites. Although there is a substantial body of literature on teaching people how to evaluate information, there is very little research on how to design systems and Web sites to include more explicit evidence of information accuracy. Fallis (2004) insists that it is important to make information more verifiable because that would give people easier access to evidence. He suggests specific ways of making information more verifiable by offering both direct and indirect evidence. One approach is to organize information in ways that enable people to locate with ease additional evidence relevant to the topic in question. In addition, information professionals can maintain metadata about the context in which information was created and disseminated.

The work of Fogg and colleagues has demonstrated various design elements that tend to influence user credibility assessments. Based on three years of research on Web credibility, Fogg (2002) developed the "Stanford Guidelines for Web Credibility" for Web designers. Its ten guidelines are as follows:

- Design your site so it looks professional (or is appropriate for your purpose). Pay attention to layout, typography, images, consistency issues, and the like.
- Make it easy to verify the accuracy of the information on your site. You can build Web site credibility by providing third-party support (citations, references, source materials).
- Show that there's a real organization behind your site. The easiest way to do this is by listing a physical address. A photo of the offices and listing a membership with the local chamber of commerce can be helpful.
- Highlight the expertise in your organization as well as in the content and services you provide. Be sure to give the credentials of contributors and service providers. Don't link to outside sites that are not credible.
- Show that real people who are honest and trustworthy stand behind your site. In addition, find a way to convey their trustworthiness through images or text.
- Make it easy to contact you. Provide your phone number, physical address, and e-mail address.
- Make your site easy to use and useful. Web sites lose credibility whenever they make it difficult for users to accomplish the task at hand.
- Update your site's content frequently (at least show it's been reviewed recently).
- If possible, avoid having ads on your site. If you must have ads, clearly distinguish the sponsored content from your own.

- Avoid errors of all types, no matter how small they appear.

Sillence, Briggs, Fishwick, and Harris's (2005) guidelines developed specifically for health Web sites share some similarities with the Stanford Guidelines. Sillence et al. proposed three guidelines based on their empirical study of trust and selection of health Web sites: (1) make the purpose of the site clear; (2) allow a personalized, tailored experience; and (3) include markers of social identity. In addition to these specific guidelines, several studies have emphasized the implications of user evaluation criteria for the design of Web pages in terms of both content and also visual appearance and interface characteristics (e.g., Ivory & Hearst, 2002; Kim & Moon, 1998; Tombros et al., 2005).

Designing Information Retrieval Systems

In the field of information retrieval, the concept of credibility has been discussed as a part of the topic of relevance judgment rather than in its own right. With few exceptions, the notion of credibility has not been applied directly to the design of information retrieval systems. Even those studies that incorporate the credibility concept have not considered the aspect of human credibility assessment. Most assume that credibility can be represented simply as attributes of Web pages or documents. This assumption is limited, for credibility assessment is inherently a matter of human judgments and document attributes provide only the cues for such judgments. In spite of these limitations, it is still important to review a few significant studies here because the credibility concept has potential to be used as a way to filter information from a huge set of relevant pages. There seem to be two primary approaches.

The first explores the analysis of link structures. Kleinberg (1999) suggested a way to filter a small set of the most authoritative or definitive pages from a large number of relevant ones. According to Kleinberg, hyperlink structures among Web pages encode a considerable amount of latent human judgment and this type of judgment is precisely what is needed to formulate a notion of credibility. He claimed that a good hub is a page that points to many good authorities and a good authority, a page pointed to by many good hubs. PageRank, as implemented in Google, also makes use of the Web link structure to calculate a quality ranking for each Web page (Brin & Page, 1998). Amento, Terveen, and Hill (2000) computed five metrics: in- and out-degrees (Kleinberg, 1999), authority and hub scores (Kleinberg, 1999), and PageRank score (Brin & Page, 1998). They revealed that simply counting the number of pages on a site gave as good an estimate of quality as any of the link-based computations. Liu, Wang, Zhang and Ma (2005) also reported differences in non-content feature distribution between ordinary and key resources pages in terms of in-degree, URL length, in-site out-link anchor text rate, in-site out-link number, and document length.

The second approach explores the attributes of the document. Price and Hersh (1999) addressed the idea of using automatic filtering techniques to identify pages likely to be of high quality. Their prototype system examined Web pages and assigned a score to indicate the likelihood that each page would meet quality criteria such as relevance, credibility, absence of bias, quality of content, currency, and value of links. The indicator for credibility was computed via several subroutines that inspected the URL, looked for authorship of the information, determined whether the site displayed the HONcode logo, and searched for particular words or phrases such as "miracle cure." Zhu and Gauch (2000) selected quality metrics in terms of

currency, availability, information-to-noise ratio, authority, popularity, and cohesiveness; they found that the authority metric was not related to search effectiveness.

Recently, Bai, Ng, Sun, Kantor, and Strzalkowski (2004) identified nine document properties and analyzed the reliability of document quality judgments. They also explored the correlation of judgments of the document properties. The document qualities examined were accuracy, source reliability, objectivity, depth, author/producer credibility, readability, verbosity/conciseness, grammatical correctness, and one-sidedness/multi-views. Factor analysis indicated that three factors of “general goodness” of documents were responsible for about 48 percent of the total variance. Document qualities of depth, objectivity, and author credibility, which were categorized as quality separators, evinced consistent patterns between two quite different kinds of collections.

A Multidisciplinary Framework

This chapter has reviewed various perspectives and empirical studies that investigate the concept of credibility across multiple disciplines and within several applied contexts. Our synthesis is organized around five topics: (1) the construct of credibility as a chief element of information quality, composed of situation-dependent dimensions and criteria for evaluation; (2) orientation toward the targets of credibility assessment; (3) credibility assessment processes, which comprise prediction, evaluation, calibration, and verification; (4) situational aspects of credibility assessment with respect to domain, user goals, motivation, environmental constraints, and organizational and social contexts; and (5) the evaluator’s background, encompassing a general stance toward new sources and information, evaluative skills, and domain knowledge.

Construct of Credibility

Researchers in information science have traditionally situated credibility in relation to relevance judgments. In particular, credibility assessments are often taken to be a subset of relevance judgments. Relevance is often defined as users’ perceptions of the potential usefulness of information; relevance judgments, as users’ decisions to accept or reject specific information items (Schamber & Bateman, 1996). When users make such evaluations, they rely on various criteria that eventually lead them to select information. Information quality, credibility, and cognitive authority are those criteria that have appeared consistently across relevance studies (Wang, 1997).

Credibility is a principal component of information quality. People are likely to believe that information is useful and accurate if it is perceived to originate from credible sources. However, not all information perceived to be of high quality is perceived to be credible. A number of other criteria, such as consistency and recency, can lead information seekers to accept information in spite of the absence of any evidence about its credibility. That is, the absence of evidence regarding credibility does not in itself necessarily hinder the assessment of information quality. Consequently, the pool of information perceived to be credible is a subset of the pool of information perceived to be of high quality. In turn, cognitive authorities within a domain are a subset of all credible sources (Rieh, 2005). That is, the set of credible sources constitutes the potential pool from which information seekers can draw cognitive authorities (Wilson, 1983).

Finally, we reiterate the importance of the object of assessment in credibility research. Information seekers’ criteria for credibility assessment are largely a function of the type of

source being evaluated. Consequently, the underlying dimensions of credibility a researcher is likely to uncover can also vary as a function of the type of source, whether it is a public speaker, an organization, a Web site, or an information system. These differences are often reflective of situation-dependent evaluative criteria. Because information technology introduces a new set of candidates for source orientation, we expect the evaluative criteria of users to be in flux when interacting with computers.

Orientation toward Targets of Credibility Assessment

It is almost universally presupposed in the research literature on credibility that a specific object (e.g., a newspaper, Web site, person) has been chosen as the target of credibility assessment. What we lack is an understanding of how this initial orientation toward a particular target occurs and, ultimately, who or what is perceived to be a source when various layers imposed by information technology tend to obscure the originator of content. In every discipline applying credibility to the use of technology, users are prone to respond to information systems themselves as if they were the source of the information they were programmed to deliver; this is a direct consequence of users' social responses to technology (Reeves & Nass, 1996).

Thus, the line between traditional notions of source and medium has become blurred. Information seekers can be doubtful of a medium, without reference to more specific sources, in much the same way they are doubtful of more traditionally recognized sources such as organizations and individuals (Rieh & Belkin, 1998). Just as importantly, information technology presents users with numerous new objects that might be perceived as sources—from physical devices to applications and virtual characters to layer upon layer of information filters. In many cases, the messenger, by virtue of its proximity to the information seeker, *is* the perceived source.

Credibility Assessment Processes

A key distinction in the literature of credibility assessment processes is between two kinds of judgments: predictive judgments made prior to accessing the object of assessment and evaluative judgments made when confronting the object of assessment. The distinction originates from Hogarth's (1987) judgment and decision-making theory and has been most explicitly applied to credibility assessment in information seeking and retrieval, where it is clear that a wide range of surrogates (such as hyperlinked text, document titles, abstracts, and the like) serve as initial indicators of credibility before the evaluator has accessed a full document. Predictive judgments, which are often subtle, become increasingly critical in massive information ecologies available through information technology; each discipline, for example, notes at least category membership as a powerful assessment cue. This is likely to be a critical shift, as work by Rieh (2000, 2002) indicates that the kinds of criteria people use for predictive and evaluative judgments differ.

Each discipline additionally includes some notion of historical or behavioral observation by evaluators and subsequent *calibration* of beliefs about a source's credibility based upon the observations made. This aspect of assessment has been particularly prominent in user interaction with autonomous decision-support and other automated systems (Muir, 1987).

Finally, credibility assessment varies in the extent to which verification procedures are likely or even possible. Web sites provide links to supporting material; expert and decision-support systems provide detailed reasoning behind a particular recommendation. Avoiding the

“black box” phenomenon in interactions with complex information systems helps users understand how the system gathers information or arrives at conclusions. Information completeness helps combat this problem. Information is complete to the extent that the possibility for verification exists. However, where verification is impractical because of time constraints and other situational demands, the mere *presence* of verification material can be the key factor influencing credibility judgments.

Situational Aspects of Credibility Assessment

Across disciplines, researchers recognize the importance of the *context* of credibility assessment—both the relatively idiosyncratic situational variables that can influence judgment and the broader social and organizational background within which assessments are made. The goals and motivations of the information seeker and constraints created by the evaluative environment can significantly influence credibility assessments.

In some instances, one’s goal not only influences the selection of sources but can cause one to *select a particular environment in which credibility assessments will be made*. A manager who is concerned with discussions being too heavily influenced by participants’ status levels might opt for a virtual meeting in which participants contribute ideas anonymously. Individuals also differ in motivation and other associated feelings of urgency; a high need for information increases one’s willingness to accept whatever information is currently available. Consumers who have already incurred the costs of traveling to a store accept comparative product quality claims readily; the online shopper, however, with no costs invested in a particular vendor remains more reasonably skeptical. As discussed in the sections on online health and general Web information seeking, the importance and impact of the information sought can strongly influence strategies for credibility assessment.

Deliberate selection of sources, media, and evaluative environments, in turn, strongly influences the criteria one will use in assessing credibility. The demands created by the medium have been of special interest to communication scholars, as different modalities (e.g., text, audio, video) place varying constraints on attention and memory. For consumer researchers, at issue are the relative abilities of consumers to recognize contextual variables that may help indicate whether a product claim or signal is reliable.

A source sits within social and organizational contexts that enhance or inhibit the accuracy of what it reports. The context can be more or less transitory and an information seeker may be only vaguely aware of how a perceived source leverages (or depends upon) a network of resources. With respect to information systems, the management and health sciences have been acutely aware of the importance of this situational aspect of credibility. Managers are as sensitive to the timeliness of information and recommendation as any evaluator, one primary reason they have traditionally depended upon observation of the external environment and highly rich media in decision making (Daft & Lengel, 1984). Health professionals, too, as we saw in our discussion of the HELP system, must rely on timely patient information, often maintained by multiple individuals over time and across an organization.

Thus, information systems in such contexts inevitably possess a *distributed* intelligence. Decision makers are not simply relying on the perceived source; they are relying on an organizational commitment and ability to place the system in the best position possible to report facts and make recommendations. Similarly, information is evaluated against a background of

social and organizational norms regarding, for example, the types of facts, reasoning, and argumentation that are considered acceptable within a domain.

Evaluator Background

The fact that individuals differ in general credulity as a trait is at least implicit in every discipline's approach to credibility research, even if the relative attention paid to this individual difference varies. Similarly, all disciplines recognize a set of individual differences with respect to goals, expertise, and the like that strongly influence credibility judgments. Communication and consumer researchers in particular have also investigated such differences as temporary states, noting for example that individuals assess credibility within contexts where the general level of credulity expressed by groups and communities is, or can be, fluid. Information seekers respond to newspapers and politicians, for example, in contexts where the general climate may favor one but not the other, neither, or both. More broadly, the context in which credibility assessments are made may favor or disfavor the trustworthiness of the "generalized other" (Putnam, 2000). Putnam (2000) gives the example of individuals living in large cities compared with those living in small towns. The relative stances that persons from these contrasting backgrounds tend to take toward new sources and new claims differ substantially; this may simply reflect the reality of the evaluator's context. Similarly, the competitive climate in which product claims and signals are made can enhance or reduce their believability and persuasiveness. Here, the skills of an information seeker in gaining a broad view of that competitive climate are critical, as we saw in examples of in-store assessments of various signals implying product quality as well as of comparative shopping.

Common to all credibility assessment research is the recognition that assessments are made in relation to an evaluator's existing knowledge and beliefs and that this background often drives information-seeking strategies. A second critical aspect of credibility assessment with information technology is the frequent need for users to develop novel evaluative skills. Examining a set of production rules explaining a recommendation by a decision-support system or examining the URL of a Web site as an indicator of credibility, for example, are not innate skills. New information technologies inevitably require users to develop new skills in deciding whom and what to believe. Finally, credibility judgments are not made simply against a background of factual knowledge and skills. They involve an assessment of, and attempt to understand, the source's goals and motivations, as exemplified in the persuasion knowledge model (Friestad & Wright, 1994).

Agendas for Future Research

Reviewing past research on credibility in various disciplines and the development of a multidisciplinary framework leads naturally to the identification of several avenues of future research. Researchers encounter challenges in understanding the concept of credibility outside of their own disciplinary arenas. Media, information retrieval systems, medical information systems, and management information systems have traditionally been studied in different academic disciplines, the distances between which have decreased dramatically in the current information environment. The following areas are suggested for future research: multidisciplinary approaches, broader contexts of information credibility, changing Web environments, subjective assessment processes, and tracking changes in credibility perceptions.

Multidisciplinary Approaches

Most studies about credibility in mass communication are carried out with respect to a particular type of information within a limited domain. Studies have been primarily concerned with news, personal Web sites, and political issue sites (e.g., Johnson & Kaye, 1998, 2002; Mashek et al., 1997; Sundar, 1999). Researchers in information science have tended to focus on scholarly information in work settings with either scholars (e.g., Rieh, 2002; Rieh & Belkin, 1998) or students (e.g., Liu, 2004; Liu & Huang, 2005; Whitmire, 2004). However, as the literature reviewed in this chapter demonstrates, people make credibility assessments both at work and in everyday life when they engage in seeking information pertaining, for example, to health, products, or hobbies. This is an important aspect of credibility research because people carry over both their perceptions and the judgment processes that they have acquired from one domain to another. Given the reality that people use the Web to conduct quotidian tasks and pursue the everyday pleasures of life (Fallows, 2004), it is extremely important for credibility researchers to employ multidisciplinary approaches.

Broader Contexts of Information Credibility

Researchers in a variety of disciplines have investigated the issue of credibility for quite some time and the Web has cast new light on the topic. It should be emphasized, however, that the Web is not an isolated medium for the playing out of information and communication behaviors. People continue to rely on a variety of information systems and resources in interacting with information and often use multiple media to resolve their problems. As a result, relative credibility across different information systems will remain a significant and interesting item on the research agenda.

In addition to investigating credibility assessment in terms of outcomes by asking people which media they trust most, it is important to understand how such assessments are influenced by the information system used: in other words, people make judgments of credibility not only after they gain information from a certain system but also in selecting the systems they use. Future studies should take account of credibility assessments over the entire process of human information and communication behavior, including the range of information systems to which people turn.

Changing Web Environments

The Web is viewed increasingly as a means of creating communities and fostering collaboration rather than simply a means of publishing and delivering documents and services (Liu, Harper, & Watt, 2005). A significant innovation is the emergence of open source production, which involves the free and open creation, alteration, and distribution of information from vast numbers of contributors (Anthony, Smith, & Williamson, 2005). Open source production gives one a sense of community membership. For instance, Wikipedia is a free, online, open-content encyclopedia in which content results from a community of editors rather than a single individual or small set of experts. The quality of Wikipedia content is much debated. Lih (2004) insists that an open-editing policy helps to control quality because the contributions have been evaluated and revised by the thousands of visitors to the site. From the perspective of credibility assessment, Wikipedia certainly offers a significant research opportunity as it provides a new form of collaborative quality control. In addition to issues of

quality control, source orientation becomes critical, as the question of who is ultimately responsible for content becomes less clear to information seekers.

Content-based recommender systems represent one more attempt to combat information overload; as with any system that filters information selectively, they are subject to credibility assessments (O'Donovan & Smyth, 2005). One interesting area for future research is the extent to which people would be likely to believe recommendations generated by these systems, especially those leveraged from the preferences of communities of similar users.

Subjective Assessment Processes

Many studies show that credibility does not reside in the information object or source itself. Rather, it is users who recognize dimensions of credibility based on the characteristics of information objects and sources and then make credibility judgments. In other words, although objects and sources provide clues that can be used to make information more believable, individuals will eventually make different assessments of information because of their experiences and knowledge. In addition to knowledge and experience, other factors associated with individual differences should be considered explicitly in future research. For instance, levels of motivation to engage in information seeking may influence the ways people assess information credibility. Attitude might be an important factor to investigate in lieu of demographic characteristics. These variables might be related to the level of mental effort that people are willing to invest in the information evaluation process.

Tracking Changes in Credibility Perceptions

According to Metzger, Flanagin, and Zwarun (2003), credibility perceptions may change over time. As seen in Johnson and Kaye's (2000, 2002) research, the credibility of online political information changed from the 1996 to the 2000 election season. As the Web has changed in terms of both audience and content, people's perceptions of the Web have altered as well. We make two suggestions for future research. One is to conduct larger-scale studies in which credibility assessments can be examined across diverse user groups. The findings of such research can be compared to previous research to determine whether there has been an overall shift in people's perceptions of credibility. The second is to conduct longitudinal studies in which researchers can observe whether users' credibility assessment processes change over time.

Conclusion

This chapter has reviewed various perspectives and empirical studies that investigate the concept of credibility across multiple disciplines and within several applied contexts. Although research on this topic has the potential to offer a useful conceptual framework with which to understand better the nature of human judgments about information, information science researchers have traditionally limited their discussions of credibility to its role as a criterion in relevance judgments. This review has illustrated the importance of understanding credibility as a focus of research in its own right. Credibility has in fact received renewed attention in various research communities partly because there are increasing concerns about the credibility of information on the Web. However, understanding the concept of credibility only in the context of information evaluation on the Web would limit the potential usefulness of the credibility concept because assessment of credibility is a ubiquitous activity of human judgment, given that people

constantly have to make decisions about the value and usefulness of information in a variety of work and everyday life contexts.

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