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Source Evaluation and Information Literacy: Findings from a Study on Science Websites

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ABSTRACT

An essential component of information literacy is the evaluation of information resources. Integral to evaluation are users' judgments about which web sources might prove reliable when learning about a particular topic. Past website quality studies have used research methods that involved asking participants to recall quality factors without the benefit of concurrent web searching. Users in this study evaluated websites during live searching on the "open" web to determine the quality factors they valued and how these relate to gaining knowledge about a particular topic – genetically modified (GM) food. Two weeks later, participants answered questions about the websites they visited and what they had learned via an email survey. The participants then reported factors that allowed them to remember a website or the information contained within it. The effect of the quality evaluation on memory for a particular resource is examined and its relationship to information literacy is explored.

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INTRODUCTION

According to many definitions, the information literate person "must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." (American Library Association, 1989) As an information source, the World Wide web has been touted as the answer to everyone's information needs. Google, one of the most popular and heavily-used web search engines "is many things to many people, and to some, perhaps too much: a dictionary, a detective service, a matchmaker, a recipe generator, an ego massager, a spiffy new add-on for the brain" (Hochman, 2004, Sec.9, p. 1). Some claim that the web is a universal library or knowledge source because the scope of web documents is so broad and they are so accessible. If a universal knowledge source were to exist, then there might be more substantial agreement about such attributes as information quality (McInerney, 2000), credibility (Dutta-Bergman, 2004; Liu, 2004; Rieh, 2002; Rieh and Danielson, 2007; Wathen & Burkell, 2002), and cognitive authority (Hong, 2006; Rieh, 2002). In the past, readers learned to distinguish the characteristics of authoritative encyclopedia entries, distinguishing factual information from opinion. For now, though, the web is still an unfettered platform where neophyte writers and professionals alike can post text, with or without editorial judgment or oversight. Throughout this paper, the authors will use the following terms to describe source judgment criteria.

Information quality, defined as the extent to which users judge an information resource as being "useful, good, current, and accurate" (Rieh, 2002, p.146), or, in other words, a perception of the information's value as described in Taylor (1985). Information quality is considered by some to be a static quality that can be assigned, especially by expert reviewers (Cline and Haynes, 2001; Curro, Buonuomo, Onesimo, De Rose, Vituzzi, Di Tanna, et al., 2004; Eysenbach, Powell, Kuss, Sa, 2002).

Credibility can be simply described as the perceived believability of the source (Fogg, Sooho & Danielson, 2002), but it is a rich and multidisciplinary construct as Rieh and Danielson (2007) have shown.

Cognitive authority is described by Patrick Wilson (1983) as recognition of the credibility and influence that a source carries for an individual. A source that is both trustworthy and competent is judged to be credible by a user. If that source also influences subsequent decision-making, then Wilson considers that source to be a cognitive authority.

Memorability is a term used by the researchers to describe the quality of an information resource that helps the user remember it.

These first three concepts, information quality, credibility, and cognitive authority are inextricably linked as described by Rieh (2002). They are central in the design and implementation of the user study discussed here.

Information quality

Before the emergence of the web, the determination of the quality of information in a given source was supported by a number of established bibliographic tools. Well-recognized guides to reference materials such as Katz's *Introduction of Reference Work* (1997) and the recent

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iteration of the work once shepherded by Constance Winchell and Eugene Sheehy, the *Guide to Reference* (Kieft, 2008-) assessed the quality of information in different sources such as bibliographies, monographs, audiovisual materials, and so on. *Ulrich's International Periodicals Directory* was a key source that provided publication and other descriptive information about periodicals, journals and magazines. This guide includes guidance on whether a particular serial was refereed or peer-reviewed, the indexes where the journal would be found, and ordering and pricing information. Used in conjunction with other sources, and the experience of the searcher him/herself, a reasonably complete understanding could be obtained of the quality of the information contained in the source. While by no means fail-safe, these tools provided a basic framework within which to make informed decisions about the quality of information contained in a publication source (Katz, 1997). The main goal of bibliographic instruction, as information literacy instruction was more commonly known at the time, was to teach effective use of these resources. (Rader, 2002)

The evaluation of web sources presents a different set of challenges. It is a multi-dimensional framework with factors such as page design or the task in which the user is engaged being somewhat important. The perceived credibility of the author and producer of a source contributes to a user's evaluation and choice to use the source and subsequently to award cognitive authority to that source. An important outcome of the research conducted by Rieh (2002) was the development of a faceted classification of the factors that bear on users' assessments of information quality and cognitive authority. Rieh found that users placed high value on the role of cognitive authority as an

influencing factor. Cognitive authority is differentiated from other factors of quality although all contribute to the multi-faceted nature of the decision making about the quality of web-based information sources. Rieh's research found that users assessed the quality of a site when they viewed it. If it were "good, useful, or trustworthy in matching their expectation, they continued to use it" (p. 156).

Rieh's faceted list joined many other researchers' and practitioners' attempts to create heuristics or checklists of criteria for evaluating websites that could be incorporated into information literacy classes.[1] Websites in the health and medical domain need careful examination; incorrect decisions about information credibility and accuracy can have serious consequences. Many articles containing expert reviews of websites' various medical topics have been written (see Cline & Haynes, 2001; Curro, et al., 2004, and Eysenbach, Powell, Kuss, & Sa, 2002, for representatives of the genre), and it was hoped that easy checklists could be generated that every information literate person could learn to use on the web when looking for information. The idea is for experts to identify the high quality websites and then teach consumers and other experts about criteria to help them find that high quality information themselves. It was in this vein that the Website Quality Evaluation Tool (WQET) was developed from a wide-ranging review of criteria that characterize high quality web information (McInerney, 2000; McInerney & Bird, 2005).

The development of quality criteria views information as external and objective, able to be subject to critical thinking and accepted or rejected by the viewer. However, in a recent work Christine Bruce argues that this is only one "window" that

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might be used to view the process of information use, which she terms informed learning (2008). She labels it the "generic window" and shows that it can be useful for learning content but does not usually lead to re-use in other situations or to deep or transformative learning (p.110). The recognition of cognitive authority, on the other hand, can lead to behavioral change. Annemaree Lloyd acknowledges this difference in a recent book in which she uses the metaphor of landscapes to describe variations in the contextual influences determining information literacy (Lloyd, 2010). She writes of five foundational parts of information practice, two of which can be used to describe the intent of the present work: 1) becoming influenced by information; and 2) making decisions on whether to accept encountered information or argue against it. In matters such as genetically modified (GM) food, where information sources can be found to support both acceptance and rejection of it as a viable consumer resource, it can be essential to understand how people exhibit these last two information practices.

Credibility

The assignment of credibility to web sources has been widely studied (Dutta-Bergman, 2004; Liu, 2004; Rieh, 2002; Treise, Walsh-Childers, Weigold, & Friedman, 2003). Liu (2004) asked college students to complete questionnaires on the reasons that they found websites credible or not credible. In general, high scores were given to content that was, for instance, trustworthy and of good quality, but scoring was done without reference to particular websites or tasks, i.e., respondents were not engaged in web behavior when they took the surveys. Similarly, Treise et al. (2003) found that domain influenced perceptions of credibility: Students reported that they

would choose *.gov* sites over *.com* sites on science topics, specifically, and the preference of .gov sites was confirmed by participants who assigned higher credibility ratings to a science story that was labeled as being from a government sponsored site. Dutta-Bergman (2004) used websites that were constructed especially for the study and differed only by completeness of the content. The main finding was that the more complete the information on a website, the more credible it was to the participants.

The study by Hong (2006) had college students choose their own websites in response to two health-related scenarios. Participants were asked to find one best smoking cessation website for each of two scenarios. They were asked to make their choices based on one that they would recommend to a friend or family member. The participants rated the credibility of the site, but two independent researchers coded the features of the website after the search sessions. The researchers found that website credibility judgment was more strongly correlated with message features, especially statistics, authorship, and information currency, than to structural web features. Interestingly, the researchers included site authorship and the presence of an awarded rating for health websites called the HON code as structural features (Health on theNet, n.d.).[2] It is not known whether the participants would have noticed and used these features as evidence during their search sessions.

Cognitive authority

As described by Wilson (1983), cognitive authority is the relationship that a user has with a source relative to a particular topic and the degree to which the source influences the behavior or ideas of the user. Information obtained during a search, by

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plan or serendipitously, may be used at another time or may influence future decisions. For instance, someone may read a web document about genetically modified foods and decide whether to purchase such products at a later time. Petty and Cacioppo (1986) distinguished two forms of learning as either peripheral, resulting in incomplete opinion change, or cognitive, leading to learning and behavior change. In assessing the characteristics of documents that may have long term impacts on memory, Mayer (2001, 2003) examined the best presentation methods for multimedia educational presentations like the proper placement of graphics and the order of presentation of certain content elements. In other words, the effect that even high quality content has on learning can be changed by graphic representations and other issues. Presenting three different kinds of tasks during an experimental situation, Tombros, Ruthven and Jose (2005) found that content was the strongest influence on decisions to use a website where 'use' was defined as choosing the website to fit the assigned questions. Assessments of useful features were derived from a think aloud protocol and from a post-search self assessment. Physical properties (or peripheral factors), such as link quality and the appeal of the layout were more likely to be mentioned when a page was judged "not useful" for the task. It would seem, then, that non-content issues can act as barriers to users when they judge the usefulness of a website.

Information professionals have held the opinion that the web is *not* a library because it lacks the organization and selection criteria that librarians have traditionally used to build library collections. Like peer review in academic publications, librarians lend authority to their material selections because of criteria carefully applied in the evaluation process prior to purchasing

decisions. The hallmarks that signal quality in a book or periodical collection, i.e., publisher, editorial process, selection, retention by a library, and longevity are not necessarily present within the web environment. With search engines leading directly to the most "relevant" webpage, section of a page, or other web element, key publication information is often missing. Alternative approaches to the determination of authority and credibility have consequently become salient with increasing use of the World Wide web. The questions of authority and credibility are especially critical in the realm of science information that once had the strongest gatekeepers, in the information world, e.g., peer reviewers, publishers, and librarians (Ziman, 1968; Wilson, 1983). Inaccurate, outdated, and deliberate misinformation can be found during a web search session with few ways to distinguish unreliable sources from reliable ones.

As we saw earlier, one aspect of the cognitive authority relationship is the assignment of credibility, or perceived believability to the source (Fogg, Sooho & Danielson, 2002); however, it is possible for a source to have credibility without cognitive authority. It may be possible to believe an information source and grant it credibility without changing an opinion or an associated behavior. When belief reaches the level of actual behavior change, then a source has cognitive authority for a reader. In Bruce's (2008) explanation of informed learning in the community or workplace, a behavioral change based on what is read or heard would be considered transformative. Similarly, in Lloyd's (2010) description of information practice the granting of cognitive authority to an information source would lead to influence over the user.

Information is the basis of learning and

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knowledge development. Many different types of libraries have realized that they are an essential component of assisting users to learn about important topics; however, few studies have really documented how the perception of quality inhibits or helps this process. This study is a small step toward the significant endeavor to make the connections between quality and learning more explicit.

CONTEXT OF THE STUDY

Lloyd (2010) notes the lack of research into the landscape of information literacy for community members engaged in lifelong learning, an echo of an exhortation by Hargittai and Hinnant (2006) to step outside of our academic communities to understand information seeking. The design of the study was intended to address such criticisms, in part, by looking at how people evaluate websites on a topic about which they might be considered non-experts. What criteria did they apply as they were working through the search process and, more importantly, what did they remember of the sites? We wanted to know if the participants could remember a site well enough after two weeks to tell us something about it, and whether the site was assessed as having cognitive authority for them.

In this particular study, the science subject was *genetically modified (GM) food*. It is an interesting topic because it involves the understanding of a complex technological phenomenon, i.e., the manipulation of plant genetic material and its impact on food production. The long term effects of ingestion of GM foods are not known, and consumers are offered GM products, although they may know little about them (McInerney, Bird & Nucci, 2004). It has been shown that most people in the United States know very little about this technology

and its presence in supermarkets and even in the food that they eat (Hallman, Hebden, Aquino, Cuite, and Lang, 2003; Hallman, Hebden, Cuite, & Lang 2004).[3] If information will help consumers make decisions about the desirability of consuming GM food, then a single website or group of websites might influence consumer choice. The information literate person is equipped to recognize and choose sources with accurate information that can eventually influence her or him, i.e., to make decisions about whether to act on it, accept it, or contest it (Lloyd, 2010).

In his overview of information seeking behavior research, T.D. Wilson (1997) included consumer information seeking as a topic that had been studied by advertising professionals but rarely by information scientists. Consumer decision-making and information seeking is more than merely researching a single product; instead, it often involves finding information about an entire class of products or processes that might be encountered in daily life. One question investigated in the present study is how people choose information to enhance their understanding of a single scientific and technological advance, i.e., genetic modification of agricultural products, which may, in turn, affect their choice of foods for themselves and their families. Just as in the case of choosing the best quality health information, selecting the best information about food – in this case, genetically modified food – requires solid information literacy skills.

METHOD

An extensive literature review was conducted on the relationship between cognitive authority and website credibility and quality. The researchers also read widely in the field of genetically modified

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food, the contextual topic used to frame the study. The design employed a "Time 1" and "Time 2" measurement where the outcome was measured by memory of a website and the factors that lead to that memorability. The information sources consisted of self-chosen web-resources. The focus was on the rating of the sites and how those evaluations may have affected the participants' ability to remember a site.

Participants

The study was given all necessary approvals by the Institutional Review Board. It was conducted using laptop computers capable of connecting to a wireless network in various rooms of the Rutgers University School of Communication and Information. Participants were recruited through flyers posted in local businesses, libraries, and apartment buildings and through listserv postings to the college community. All communication between the researchers and the participants in preparation for the onsite experiment as well as follow up research was done through email which served to ensure that participants had at least minimal familiarity with online communication. The recruitment notice advertised for "Community participants…for a study about food, agriculture and the environment. This study will include searching for information on websites." The participants were given $25 for two hours of their time. Forty people came to campus to conduct web searches in six sessions with each session having between one and nine participants. Twenty participants identified themselves as Rutgers University students after they were recruited and 20 were community members. Most of the participants were in the 18-30 age group (n=27), and slightly more than half the participants were female (n=22).

Research Instruments and Procedures

The protocol consisted of three phases. The first used a paper-based pre-searching Knowledge Survey of 14 questions that sought to collect demographic information and to measure the baseline knowledge the subjects had on the search topic (See Appendix A). The second phase involved searching for and choosing "best" websites on the topic of genetically modified food, reading through the sites, and then rating three of the chosen sites using a pre-tested paper instrument, the Website Quality Evaluation Tool (WQET) (McInerney, 2000; McInerney & Bird, 2005). The third phase of the experiment was a web-based follow-up survey that participants completed online at least two weeks after the on campus study was conducted. In the follow-up, participants were asked to name a website that they could remember, to give two reasons why it was memorable, and to report what they had learned about the topic during the session. Although participants were asked to give the website URL or name, they could also describe characteristics of a site, and this information was matched to the sites that they had rated previously. Each participant was given a numbered code that was the only identifier on all of the instruments.

Search sessions. The computers were set-up with Internet Explorer as the default browser and Google as the default search engine. Participants were told that they could use alternative search engines if they wished. As the participants worked, they were asked to bookmark or "add to favorites" sites that they found to be helpful to them in answering the questions that they had been asked in the pre-search. They were then asked to choose three of those viewed

sites and rate them using the modified version of the WQET (McInerney, 2000). The WQET had been used by library students and others to evaluate websites over a period of three years. In the original WQET there were several questions probing the quality of each dimension; however, the modified version had a single question for each dimension in order to simplify and streamline the evaluation process.

Follow-up survey. The participants were contacted by email two weeks after the searching session and asked to link to a web-based follow-up survey (See Appendix B for the text of this instrument.). There are few models that suggest the optimal time to allow between a user study and a follow-up survey, since few researchers conduct follow-up studies (Julien & Duggan, 2000). A moderate amount of time (two weeks) was chosen so that the researchers could easily keep in touch and allow participants a reasonable opportunity to remember the websites. The online follow-up survey asked the participant to name a website he or she remembered from the searching session, and to give either the name, a description of the site, or the URL. They were then asked to choose a first and second most important factor from among seven quality factors that contributed to making the website memorable. Two open-ended questions asked what the participants learned from the site and what they now knew about genetically modified foods after their participation in the study. These two questions contributed to the analysis.

Data analysis

All survey response data were entered in Excel worksheets and transferred to SPSS for analysis. Qualitative data were typed from the worksheets or transferred from the Access database that contained the follow-

up survey data, and the content was analyzed by two researchers and matched to elements on the WQET. The reliability coefficient for the content analysis, Cohen's kappa, was calculated at .55, but this score was improved through subsequent discussion of the differences in coding. In the website evaluation analysis, the URLs were truncated to include the stem only through the top level domain name (the letters that follow the dot in a URL address, .edu for an example) to identify the main page of the site and to ease comparisons between participants' choices.

FINDINGS

Forty participants completed the first two phases of the research, and the results are reported in the next sections of the paper.

Characteristics of sites chosen by participants

Participants were asked to choose three websites that helped them answer the questions posed in the Pre-search Knowledge Survey (see Figure 1). The chosen materials did not necessarily fit a standard definition of a website, that is, a collection of webpages (website, 2005). As can be seen in Table 1, a number of the 20 most often rated items consisted of a single page of information, and included individual articles from the *New York Times*, a weblog, a topic overview from *Cambridge Scientific Abstracts,* and even a search engine. In total, 71 items were deemed helpful in answering questions and subsequently rated, some of which were chosen by more than one person. The 20 listed in Table 1 were the only ones that were rated by at least two participants.

A frequently used indicator of website

TABLE 1 — MOST FREQUENTLY RATED URLS	
URL (sponsor)	**Times Rated**
www.csa.com (Cambridge Scientific Abstracts	9
www.bionetonline.org/ (Bionet)	6
www.organicvalley.coop (Organic Food Seller)	6
www.bbc.co.uk (BBC)	4
www.fda.gov (USFDA)	4
www.foodpolicyinstitute.org (Rutgers University)	4
scope.educ.washington.edu (consortium of universities)	3
www.actionbioscience.org (American Inst. of Biol. Sci.)	3
www.biomedcentral.com (open access publisher)	3
www.cqs.com (Jonathan Campbell)	3
www.howstuffworks.com (online encyclopedia)	3
www.ornl.gov (Oak Ridge National Labs)	3
www.biology-online.org (Richard Lees)	2
www.foodfuture.org.uk (Food and Drink Federation)	2
www.globalissues.org (Anup Shah)	2
www.monsanto.com (Monsanto Corp.)	2
www.nytimes.com (New York Times)	2
www.scienceblog.com (Sebastian Schmieg)	2
www.thecampaign.org (Campaign Against GM Food)	2
www.ucsusa.org (Union of Concerned Scientists)	2

FIGURE 1 — PERCENTAGE OF RATED WEB OBJECTS IN EACH TOP LEVEL DOMAIN
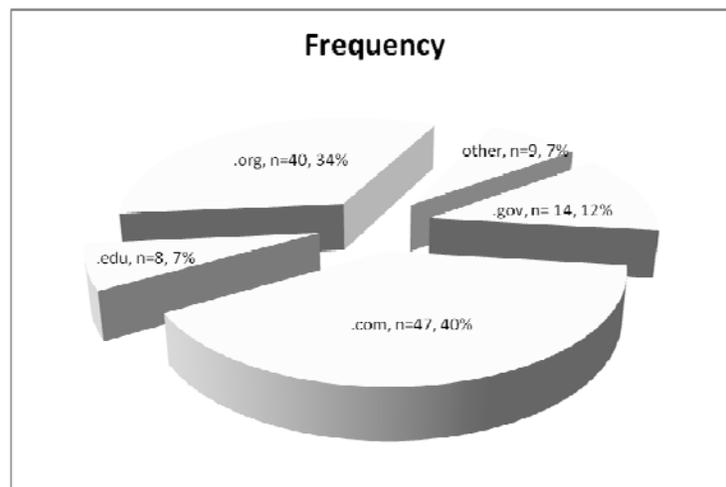
quality is the top level domain name of the website under consideration. In fact, it is included in the full list of questions that inform the authority factor of the WQET. However, its value to users may be overstated. When looking for the "best" websites, participants were much more likely to choose a commercial or organizational site rather than the educational or government sites valued in other studies. This can be seen in Figure 1.

Quality ratings of web objects

A total of 117 quality ratings of the 71 unique web items were completed by the participants using the WQET. The participants were asked to rate the three best websites that they found. Despite the possibility of skewing answers by asking for the "best," low ratings were assigned by some participants. The variability of ratings was strongest in the graphics and currency factor of the quality rating as illustrated by the median scores depicted in the boxplots in Figure 2. These results are born out in the narrative responses, which will be discussed in the next section.

The participant website ratings were not correlated in a statistically significant manner with any of the demographic characteristics such as age, education level, or university affiliation, that were collected on the pre-search survey according to the nonparametric Kruskal-Wallis tests that were applied.

Narrative responses for helpfulness of sites

The participants were given an opportunity to comment on how the rated site was helpful to them, and most were able to provide such commentary. These narratives were read by two researchers who sorted the comments into categories that matched those used on the WQET. Each of these will be described in turn below.

Content. The participants gave high ratings to content (See Figure 3) and this was reflected in the large number of comments on helpfulness that were related to this characteristic (67 of 117). The information on a website could be quite elementary and basic and still be deemed sufficient by the

FIGURE 2 — QUALITY CRITERIA OF THE WEBSITES
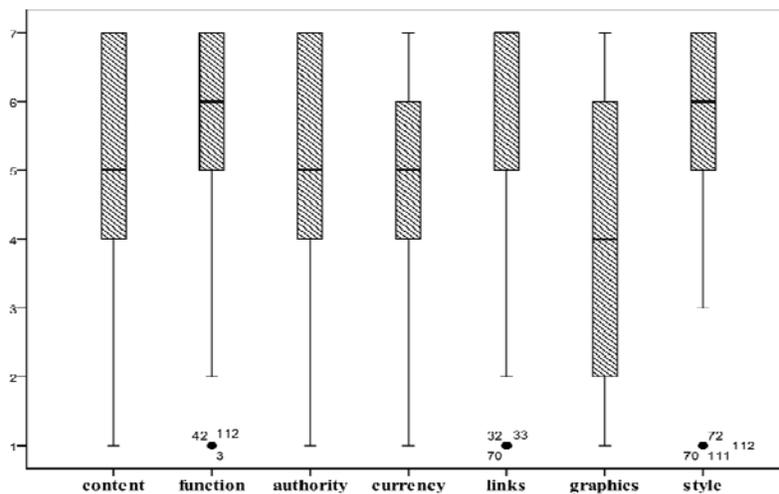
participant. For instance, one participant said, "The site provides very basic information, but fails to do something extraordinary. However, compared to other sites, it does sum everything nicely…." (Participant 22). Another noted that, "The site was very informative. However, I felt that some of the information was very vague" (Participant 24). Participant 27 said, "This website gave me an initial understanding of GM foods. It gave historical evidence, then possible harms and examples of foods that are being currently genetically modified."

Functionality. Only two of the helpfulness comments were related to the functionality of the site. One example is this comment: "I found this site to be very 'user friendly' and easy to navigate" (Participant 39). The high median for the characteristic of functionality on the WQET also indicates that there were few problems with using the websites that were found.

Authority. Authority was the second most often mentioned category of comments (26 out of 117). Respondents in general appreciated sites with a balanced view reflected in the following: "The site provides good information as well as a two-sided argument listing pros and cons of GMF" (Participant 34). Many respondents felt that they could ignore the biases that they recognized and just absorb the information. "Although a bit biased in its portrayal of GM foods as something harmful, it does offer good general info…," said Participant 22, and "While it is self-serving and therefore suspect, this site gave me the best look at how people feel about GM food," according to Participant 13. Sometimes bias did interfere with gaining information from a site, for instance, Participant 33 remarked "They don't really provide any real evidence that GMF harms

the body, but their rhetoric is persuasive."

The participants stated their confidence in a site in terms of credibility. Two examples of credibility judgments by participants include the following: "I consider it credible because there seems to be no agenda," said Participant 32, and "The author scientifically and credibly presented several key aspects of GM foods," indicated Participant 7. 'Organizational sponsor' was often cited as a reason for using the page. For instance, Participant 30 said, "…by PBS.org so it has credibility, reliability…." Sometimes the domain was seen as important, even when other factors may have been indicative of credibility problems. "It is a government website, which makes the information see(m) more credible. There are no citations or sources, however" said Participant 16. These responses highlight the importance and complexity of credibility decisions for web materials and the competing factors that are calculated into the quality judgments of users.

Currency. Participants recognized that content might not be up-to-date, but it did not deter them from using the information on the site if they trusted it for other reasons. One respondent wrote, "This site had links to other fed government sites. Many of the articles were 4-5 years old," (Participant 10) and another said, "The N.Y. Times articles were out-of-date but the site was otherwise simple and useful" (Participant 18).

Links. The median score for links was seven (out of a possible high score of seven), indicating that the links were considered high quality. The accessibility of the content of a web page was sometimes impeded by problems with functionality, as in this statement, "This site does not only focus on GM foods. I need to locate the link

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for GM foods" (Participant 8). "The links are very reliable," said Participant 14.

Graphics. Graphics had the lowest median of any of the WQET characteristics assessed (see Figure 3). However, graphics were valued for their helpfulness when they were available. The contrast is evident in these two statements: One respondent wrote, "It was very descriptive had pictures and diagrams" (Participant 26). Participant 24 commented on another site, "…it contains great information but the structure and presentation of information is horrible and unentertaining" (Participant 24).

Style. Style was not mentioned often as a helpful characteristic. Certain stylistic characteristics were noted. Participant 25 said, "The site functions as a teaching tool and thus presents the material in a clear, easy to understand manner." Another component that refers to both style and content was cited this way, "Site is very accessible and all unfamiliar words can be

clicked on to reveal the definition" (Participant 32).

Factors that helped memory

On the follow-up survey, participants were asked to identify two quality factors that aided memory of one of the sites that they had rated. The response numbers were high, but not as high as researchers had hoped (35 of 40 participants or 87% answered the follow-up survey), because it is difficult to motivate people to complete such a survey after they have left the research site. Achieving an 87% survey completion after the initial user study and after receiving the stipend for their time is still satisfactory.

Some participants could not remember a site either by name or URL; however, a few could recall details about a webpage and, for those people, the researchers supplied the URL from those that had been rated by the participant during the original session. For example, the description "it was by a

FIGURE 3 — WEBSITE QUALITY FACTORS THAT INFLUENCED THE MEMORABILITY OF A WEB OBJECT
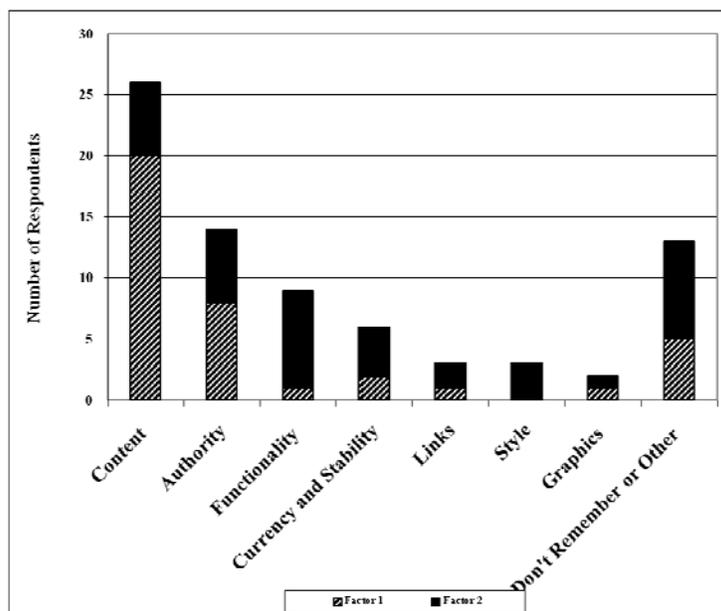
TABLE 2 — WEBSITES REMEMBERED BY RESPONDENTS IN THE FOLLOW-UP SURVEY	
Sites remembered by name or URL (sponsor)	**Number of respondents**
http://www.bbc.co.uk (BBC)	2
http://www.cfsan.fda.gov (USFDA)	1
http://www.csa.com (Cambridge)	2
http://www.dogpile.com	1
http://www.foodpolicyinstitute.org (Rutgers University FPI)	2
http://www.fpc.state.gov (US State Department)	1
http://www.google.com	1
http://www.howstuffworks.com	1
http://www.monsanto.com	1
http://www.organicvalley.coop	2
http://www.pbs.org (PBS)	1
http://www.usda.gov (US Dept. of Agriculture)	1
http://www.who.int (World Health Organization)	1
http://scope.educ.washington.edu	1
http://www.actionbioscience.org	1
http://www.colostate.edu (Colorado State University)	1
http://www.csa.com	1
http://www.foodfuture.org.uk	1
http://www.sfgate.com (San Francisco Chronicle)	1

Hungarian scientist" could be matched to one of the three URLs that this particular participant had rated during the website evaluation phase. All websites, mentioned or recalled, were checked against those that had been evaluated during the in-house search sessions. All had been previously viewed and rated by the participants. The resulting list of remembered websites is in Table 2.

The participants were asked for two factors that influenced how memorable a site was to them. The two factors are shown in Figure 3 and, as can be seen, the participants favored content and authority as aiding memorability. Structural issues such as functionality, style and graphics, were also considered necessary. Participants chose these factors as playing important roles in memorability.

Limitations

Although the researchers were pleased that they were able to go beyond the campus gates to work with community members, there were still limitations in the sample and the methodology. There were only 40 participants who took part in the study. Twenty were university students (full or part time, graduate and undergraduate) and 20 were community members with no direct connection to the university. This is not considered a small number, however, in user study research. The commitment on the part of each participant was two hours, and the tasks to be performed were challenging. Another limitation might be that the website evaluation scores may have been skewed positively because participants were asked to rate the three *best* websites that they found and viewed.

The follow-up survey question relating quality factors to help in remembering a site

(Appendix B, Question 2) did not have randomized response options, and this situation may have led to response bias. This problem may have been ameliorated, though, by the collection of the helpfulness data (Appendix B, Question 3). The top factors for memorability in a website, content and authority, were also aligned with characteristics most often mentioned for the helpfulness during the search sessions. The study is not generalizable because participants were volunteers, but the results do contribute to knowledge about users' assessments and memory of websites.

DISCUSSION

One of the most striking results of the study is the breadth of the web documents that were chosen for rating during the evaluation phase. A weblog, a research report from a science research group at an educational institution, and *New York Times* articles were rated equally as long as users found that these web objects conveyed relevant information. Even when asked to note and rate particular features of a site, factors like currency were ignored by some participants in favor of the usefulness of the content for the task at hand – in this case, answering the specific questions that were asked. Although users noted the lack of currency in their assessments, they still included some non-current sites among the three best that they had viewed. The fact that users would still choose sites with dated information and name them among the "best" websites violates many of the criteria laid out in standard information literacy evaluation schemes. Yet, even in the highly educated community in which the study was conducted, real information practice is guided primarily by the context of the question and that question focuses users on content as the primary criterion.

It was difficult for the researchers to agree on a common term that described the variety of items that were rated by the participants in this study. Some were sites with many links and multiple pages, some were .pdf documents, some were tools, such as search engines, and others were a single html page. We settled on '*web object'* which imparts a view of a self-contained entity in many guises. Researchers have tried to identify individual elements of content that are useful to information seekers (Tombros, Ruthven & Jose, 2005), but the present study shows what happens when a web *object* has too few authority and currency indicators easily available to the searcher. Unless readers can find out about the dates and sponsorship of what they are reading from embedded metadata or other indicators in addition to the simple information elements returned from a search engine, they may continue to be uninformed about the authority, credibility, or reliability of the information found.

> CLEARLY, USERS CARE ABOUT CONTENT. CONTENT IS WHAT THEY FOUND, WHAT THEY JUDGED TO BE HELPFUL, AND WHAT THEY COUNTED AS MAKING A MEMORABLE WEBSITE.

As Patrick Wilson stated, very little knowledge is derived first hand. This is reaffirmed in a statement by one of the study participants, "You cannot see or taste that a food have (sic) been modified but you can read about it…" (Participant 26). The decision not only to trust an information source, but to give it cognitive authority and influence over the choice of food products available for purchase is a serious one. The present study has shed some light on the characteristics of a website that allow people to grant it cognitive authority as evidenced by their remembering the source and its content.

During this study all searchers were looking for information on the same topic during an imposed task. Although topicality or content was a strong influence on the websites that were chosen, the subsequent ratings showed that other factors also played a role. Graphics was the most variable factor rated by the participants. The quality of a website's graphics was noted, but graphics did not necessarily interfere with remembering content and conferring cognitive authority to a website. The median scores for graphics were lower, in fact, than for any other rated factors, yet they were still valued by some participants for helping them to remember a visited site (see Figure 3). Educational psychology research has pointed out the value of graphics for communicating science information (Mayer 2001, 2003). At least one participant agreed, and wrote the following during the evaluation phase: "It was very descriptive had pictures & diagrams. Explained what DNA is. Also explained what GMF was." (Participant 26) Overall, however, graphics were less important for memorability than content or authority. Yet, if Mayer (2001, 2003) is correct that graphics leads to more cognitive learning, or to the transformative learning described by Bruce, then graphics may play a larger role than is indicated by our results.

The results also confirmed that what Hong (2006) called "message features" and what is here called "content" is the most important information characteristic to web users. This reliance on content over other

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factors also confirms the findings of Tombros, Ruthven and Jose (2005). Clearly, users care about content. Content is what they found, what they judged to be helpful, and what they counted as making a memorable website. Users do care about other characteristics. Authority, as mentioned in statements concerning sponsorship and bias, was invoked as being helpful in learning about the topic at hand. Authority was also the second most important factor participants mentioned when they wrote about the factors that made a website memorable.

CONCLUSION

One of the main goals of standard information literacy sessions in settings as diverse as higher education, K-12 schools, and public libraries is that people should be able to evaluate the information sources that they encounter. Understanding the factors that bear on how users make assessments of the quality and cognitive authority of web-based information sources is an important dimension of assessing how to support these judgments in information systems and in other ways. The present study examined such interactions as users who sought information about genetically modified food on the web and assessed the quality of the web *object* that contained the information . There are numerous factors that enter into users' assessments of website information quality, each contributing to the overall assessment, but content and authority were the important factors that users identified when they were asked to recall a visited site. It may be argued that remembering a website is not sufficient to indicate influence; however, research in the use of traditional libraries shows that willingness to return to a source indicates trust (Durrance, 1995). Research also indicates that users do not go to known websites

when seeking medical information (Fallows & Rainie, 2002) but open themselves up to search engine results returned during a new search. Returning to a site would indicate that the result of the first evaluation was to award the source authority and influence over the users' subsequent behavior, even in the absence of memory of specific content. It may be productive for future studies to concentrate on the ability to get back to a site rather than to remember its name or its URL. New technologies may facilitate the return of users to particular sites by the use of "apps" on smart phones and other reminders. Though bookmarks were used by the participants in the study, the use of technologies to return might be an interesting area of research. As Williamson, Bernath, Wright, and Sullivan (2007) note, the use of information and communication technologies must be constantly updated and expanded as the technologies change.

The researchers found that users do not always "land" on the homepage of a website from a search engine link; consequently, what the user finds may be a web object that could be a .pdf file, a chart, a blog, or an essay that appears in the middle of a website. Users may have few clues as to the source or sponsor of the information. Hence, it may be difficult to know whether to believe or act on information found through a website link. Instruction should emphasize understanding authorship cues, purpose of a site, and currency. It might also help if web developers would take note that documentation or metadata should be provided for researched information, statistics, and data presented on any page. It is useful for information users to know when the information was posted, who posted it, and what kind of authority the source has. Too often, however, these "publication" or metadata items are missing on a particular web object. Embedding more

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of this information within each object can be very useful and provide more disclosure of the information's source and sponsor. Information literacy classes should note the problems with picking items from a search engine results list and provide strategies for obtaining the sometimes hard to ascertain metadata that is necessary to make informed choices.

Cognitive authority is not simply providing the right answers as so many health website quality studies seem to imply but actually influencing what people think long after they have completed an informational search. Perhaps with specific information literacy training, the participants in this study would have noted the problems with currency, for instance, but task seems to trump education about other acknowledged quality factors. It should be noted that a more naturalistic task as opposed to an imposed task may yield different results (Snow & Katz, 2009). Though the imposed task makes it easier to compare the actions of a group, there is value in motivation and better understanding of the topic. Studies like this one with a self- generated question might be useful if a comparison mechanism could be devised. Testing the knowledge of quality factors among different populations (variety of age groups, educational background, professions, socio-economic factors, etc.) would give those interested in information literacy a more complete picture of the state of understanding web information with a view to effective interventions and education. It might be good for participants in future research to choose a subject with which they have a well-developed background or expertise.

The ability to engage in information practices that lead to informed learning is the outcome toward which all information literacy efforts are striving. Memorability

may not be the best measure of influence since so few of the sites that were visited were remembered after a two week period but continuing this line of inquiry is a worthwhile pursuit for information behavior researchers.

NOTES

1. There are a number of classic checklists including one of the first by Tillman (2003) originally published in 1995. See also Dragulanescu (2002) for another example of criteria.
2. Expert evaluation of websites is not often done since the establishment of the Health on the Net website and the HON code award.
3. A summary of five years of surveys completed in 2006 for the PEW Initiative on Food and Biotechnology concluded that public awareness of GM food had peaked in 2001 and had remained stable at near 40% (Pew Initiative on Food and Biotechnology, 2006).

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APPENDIX A — PRE-SEARCHING KNOWLEDGE SURVEY

Tell us about yourself -------------Your code _____

1. Gender _____Female _____Male

2. Age ___18-30 ___31-40 ____41-50 ___51-65 ____over 65

3. What is the last science course that you took _____

4. How long ago? (approximately) _____

5. What is your educational background? ____high school graduate ____associates degree ____college graduate ____graduate degree (master's or doctorate)

6. I am a student at Rutgers University _____Yes _____No

Please take a few minutes to answer the following questions. Your answers will provide us with some understanding of what you already know about genetically modified foods.

7   Describe what you know about genetically modified food.--

_____

_____

8. Tomatoes genetically modified with genes from catfish would probably taste fishy?
_____true   _____false

9.   By eating a genetically modified fruit, a person's genes could also become modified?
_____true   _____ false

10. Genetically modified foods are created using radiation to create genetic mutations?
_____true   _____false

11. As far as you know have you ever eaten any food containing genetically modified ingredients?
____yes ____no ____don't know

12.   As far as you know are there any foods containing genetically modified ingredients in supermarkets now?
____yes ____no ____don't know

13. I think it is safe for me to eat genetically modified food (check one)
        ____a. Strongly Agree   ____ b. Somewhat Agree ____ c. Somewhat Disagree
        ____d. Strongly Disagree ____e. Don't know

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14. Should genetically modified foods be labeled?
_____a. Strongly Agree   _____ b. Somewhat Agree _____ c. Somewhat Disagree
_____d. Strongly Disagree _____e. Don't know

Thank you – now we will proceed to the experiment.

APPENDIX B — MODIFIED WEBSITE EVALUATION TOOL

Your Code _____

Now choose the three websites that you feel were the best and fill out the following for each site. Use the following tool for each site that you found helpful.

Website Quality Evaluation Tool

Website URL	
Website Title	
Author or Sponsor	

 Choose a rating between 1 (poor) and 7 (excellent) for each of the following:

___**A. Content** [1-7]
    Is there evidence that the information is accurate?
___**B. Functionality** [1-7]
    How easy is it to navigate through the site?
___**C. Authority** [1-7]
    How credible is the information on the site? Consider the sponsor/author.
___**D. Currency and Stability** [1-7]
    Is the material up to date?
___**E. Links** [1-7]
    Are connections live and reliable?
___**F. Graphics** [1-7]
    Do the graphics enhance the information and understanding of the site material?
___**G. Style** [1-7]
    Does the site demonstrate a consistent, clear style?

3. Please comment on how this site helped you learn about GM foods. Use the back of this sheet if necessary.

_____

_____