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The relationship between undergraduates' epistemological beliefs, reflective judgment, and their information-seeking behavior ☆

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Abstract

During the fall 2001 semester 15 first-year undergraduates were interviewed about their information-seeking behavior. Undergraduates completed a short-answer questionnaire, the Measure of Epistemological Reflection, measuring their epistemological beliefs and searched the Web and an online public access catalog using tasks from the Reflective Judgment Interview that assessed their reflective judgment level. Undergraduates talked aloud while searching digital environments about the decisions they were making about the information they encountered while transaction analyses software (Lotus ScreenCam) recorded both their search moves and their decision-making through verbal protocol analysis. Analyses included examining the relationship between undergraduates' epistemological beliefs and reflective judgment and how they searched for information in these digital environments. Results indicated that there was a relationship between epistemological beliefs and reflective judgment and information-seeking behavior. Undergraduates' at higher stages of epistemological development exhibited the ability to handle conflicting information sources and to recognize authoritative information sources.

Keywords: Epistemological beliefs; Reflective judgment; Information-seeking behavior; Undergraduates

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1. Introduction

Undergraduates who are seeking information to complete academic assignments are increasingly turning to the Web for information because of convenience and accessibility. Unfortunately they often stumble upon an overwhelming number Web sites while searching. How do undergraduates' analyze and critique this unfiltered information source? Unlike most print resources that undergo a refereeing process, material on the Web does not always go through the same type of scrutiny. It is up to Web searcher to make judgments about the information encountered while searching.

One form of analysis is source criticism that involves checking the authenticity and reliability of a source. This is more complex in the Web environment where most of the credibility controls usually available for information in print are absent. In print sources the author, the author's affiliation, the publisher, etc., can be considered cognitive authorities or people or things deemed reliable (Wilson, 1983).

Many library and information science (LIS) studies have examined how users address the credibility of the information they encounter on the Web. Most recently Rieh (2002) developed a model of judgment of information quality and cognitive authority. She interviewed fifteen faculty and doctoral students and had them complete tasks while searching the Web while she captured their search moves and verbalizations which she later analyzed. Her final, revised model demonstrates that individuals make judgments about information encountered on the Web based upon the characteristics of information objects—type, title, content, organization/structure, presentation, graphics, and functionality, information quality—good, accurate, current, useful, and important, characteristics of sources—URL domain, type, reputation, one-collective, author/creator, and credentials, user's knowledge—domain knowledge, system knowledge, first-hand experience, and second-hand knowledge, the type of task that are completing, and other factors such as situation, ranking in search output, and general assumption.

Wathen and Burkell (2002) reviewed the literature about judging the credibility of information encountered on the Web. They developed an untested model which proposed that when a user encounters a website they evaluate the surface credibility of the site—appearance, usability/interface design, and the organization of information, they evaluate the message credibility via the source—expertise/competence, trustworthiness, credentials and the message—content, relevance, currency, accuracy, tailoring, and they evaluate the content (ex., how does the information match my previous knowledge?).

This study argues that users already have ideas about how they view and construct knowledge and they carry these views to their encounters with information in digital environments. Everyone has epistemological beliefs about the nature of knowledge and when they encounter information in digital environments they make judgments about the information based upon these epistemological beliefs.

Studies in the field of educational psychology have examined the impact on epistemological beliefs on various educational issues. One researcher has developed a quantitative research program that explores epistemological beliefs. She has created an instrument, the Schommer Epistemological Questionnaire, a 63-item instrument (Schommer, 1990). Repeated factor analyses on different populations have yielded four factor scales. She believes that epistemological beliefs are composed of these four independent beliefs—fixed ability, quick learning, simple knowledge and certain knowledge. She defines *certain knowledge* as beliefs about the stability of knowledge

(ranging from knowledge is certain to knowledge is tentative); *simple knowledge* is the structure of knowledge (ranging from knowledge is organized as isolated facts to knowledge is organized as integrated conceptions); *fixed ability* is the control of learning (ranging from the ability to learn is genetically determined to the ability to learn is enhanced through education and experience) and; *quick learning* is the speed of learning (ranging from learning is quick or not-at-all to the speed of learning is gradual) (Schommer-Aikins & Hutter, 2002, p. 8). In one of her first studies, undergraduates completed the Schommer Epistemological Questionnaire and then read passages and wrote their own conclusions. She found that undergraduates who believed in quick learning performed poorly on the exercise (Schommer, 1990). In her most recent study, adults completed the questionnaire and answered questions about controversial issues from a local newspaper. The authors found that people who believed that knowledge is complex held multiple perspectives on the controversial issues and were willing to withhold judgment until more information was available (Schommer-Aikins & Hutter, 2002). These findings could be of potential value to research in LIS who are exploring individuals' information-seeking behavior.

Few researchers in the LIS field examine epistemology in relation to information-seeking behavior. One exception is Hjorland (2002) who argues that depending upon the epistemological school a person belongs to an individual will have different views about the relevance criteria used to judge information. In his study he examined citations in journal articles representing four different paradigms in the field of psychology: behaviorism, cognitivism, neuroscience, and psychoanalysis. He defines relevance as the citations in the journal articles. Hjorland (2002) establishes relevance criteria in four epistemological schools: empiricism, rationalism, historicism, and pragmatism. For each school he defines what types of evidence is considered low priority or non-relevant.

Another study examining the relationship between these two constructs used a qualitative approach. Whitmire (in press) explored the relationship between epistemological beliefs and information-seeking behavior. Twenty undergraduates attending an Ivy League institution were interviewed about their information-seeking behavior while completing their senior theses. During their interviews they were asked questions about how they judged the credibility of the information they encountered and how did they handled the conflicting information they came across during the search process in order to determine their epistemological beliefs. Analyses of the interviews revealed that epistemological beliefs affected choice of thesis topic, the use of mediators during the search process, search techniques, the evaluation of information, and the ability to recognize authority. The purpose of this study is to extend the findings of the previous studies by examining the relationship between epistemological development and information-seeking behavior.

2. The theoretical framework

Two models of undergraduates' epistemological development from the higher education and educational psychology literature inform this study and provide the theoretical foundation.

2.1. The epistemological reflection model

Baxter Magolda (1992) developed the epistemological reflection model that addressed the gender biases found in the Perry (1999) and Belenky, Clinchy, Goldberger, and Tarule (1986)

models of epistemological development. She tested both men and women using the same instrument, the Measure of Epistemological Reflection (MER). The Epistemological Reflection Model is "based on the students' perceptions of the nature of knowledge, it describes the four ways of knowing and their development throughout the college experience" (Baxter Magolda, 1992, p. xii). The ways of knowing range from believing that knowledge is simple to believing that knowledge is complex and contextual.

2.2. The reflective judgment model

King and Kitchener (1994) developed a seven-stage model examining "the ways that people understand the process of knowing and the corresponding ways they justify their beliefs about ill-structured problems" (King & Kitchener, 1994, p. 13). They measure reasoning ability with the Reflective Judgment Interview (RJI). Their model contains seven stages of development:

Stage 1. Knowledge is assumed to exist absolutely and concretely. It is not understood as an abstraction. It can be obtained with certainty by direct observation.

Stage 2. Knowledge is assumed to be absolutely certain or certain but not immediately available. Knowledge can be obtained directly through the senses (as in direct observation) or via authority figures.

Stage 3. Knowledge is assumed to be absolutely certain or temporarily uncertain. In areas of temporary uncertainty, only personal beliefs can be known until absolute knowledge is obtained. In areas of absolute certainty, knowledge is obtained from authorities.

Stage 4. Knowledge is uncertain and knowledge claims are idiosyncratic to the individual since situational variables (such as incorrect reporting of data, data lost over time, or disparities in access to information) dictate that knowing always involves an element of ambiguity.

Stage 5. Knowledge is contextual and subjective since its filtered through a person's perceptions and criteria for judgment. Only interpretations of evidence, events, or issues may be known.

Stage 6. Knowledge is constructed into individual conclusions about ill-structured problems on the basis of information from a variety of sources. Interpretations that are based on evaluation of evidence across contexts and on the evaluated opinions of reputable others can be known.

Stage 7. Knowledge is the outcome of a process of reasonable inquiry in which solutions to ill-structured problems are constructed. The adequacy of those solutions is evaluated in terms of what is most reasonable or probable according to the current evidence, and it is reevaluated when relevant new evidence, perspectives, or tools of inquiry become available (King & Kitchener, 1994; pp. 14–15). These seven stages are divided into three phases and are sequential and hierarchical: pre-reflective, quasi-reflective, and reflective.

The epistemological reflection model examines how individuals make sense of their educational environments based upon their epistemological beliefs while the reflective judgment model examines how epistemological beliefs affect thinking and reasoning processes. Specifically, the reflective judgment model examines how individuals make reasoned judgments about ill-structured problems, i.e., problems with no right or wrong answers, in the face of uncertainty. Table 1 compares the relationship between the stages of the two epistemological development models.

Table 1
A comparison of the stages of the epistemological development models

Levels	Epistemological reflection model	Reflective judgment model
1	*Absolute knowing*—Knowledge is certain or absolute	*Pre-reflective thinking*—Representing stages 1–3. Belief that there are right and wrong answers and only authorities know the right answers
2	*Transitional knowing*—Knowledge is partially certain and partially uncertain *Independent knowing*—Knowledge is uncertain–everyone has own beliefs	*Quasi-reflective thinking*—Representing stages 4 and 5. Begin to question previously held assumptions and realize that authorities can be wrong or biased. Realize that there can be more than one "correct" answer to a problem
3	*Contextual knowing*—Knowledge is contextual; judge on basis of evidence in context	*Reflective thinking*—Representing stages 6 and 7. Belief that "knowledge must be understood in relationship to the context in which it was generated" (King & Kitchener, 1994, p. 17)

See Hofer and Pintrich (1997) for an overview of these and additional epistemological development models.

The research questions guiding this study are: What are undergraduates' epistemological beliefs and reflective judgments?, Is there are relationship between epistemological beliefs and reflective judgments? and Do epistemological beliefs and reflective judgment affect information-seeking behavior?

Academic librarians should find the results of this study interesting because learning how undergraduates view and construct knowledge and make judgments about the information they encounter while searching can result in the provision of better reference services (Elmborg, 2002). Researchers in LIS who are interested in information-seeking behavior will also find this study interesting because although many LIS researchers examine the relationship between cognitive behaviors and information-seeking behavior, the relationship between epistemology and information-seeking behavior is an underdeveloped area of exploration.

3. Methods and procedures

Initial investigations of the relationship between undergraduates' epistemological development and information-seeking behavior included an exploratory study of 20 fourth-year undergraduates at Yale University (Whitmire, in press). Based upon feedback, additional elements were added to the study including instruments to assess levels of epistemological beliefs and reflective judgment and exercises designed to assess information-seeking behavior in digital environments. A pilot study of this research was conducted during the summer 2001 using four undergraduates as the research subjects enrolled in the same university as the subjects in this study.

3.1. Subjects and setting

During the fall 2001 semester 15 first-year undergraduates were interviewed about their information-seeking behavior. Nine of the subjects were female and six male. The pilot study and

the interviews took place in the United States at a research I university in the Midwest—in the University of Wisconsin (Madison), School of Library and Information Studies' Usability Laboratory.

The undergraduates expressed interest in majoring in a number of disciplines including: civil and environmental engineering, biomedical engineering, computer engineering, chemical engineering, accounting, communications, undecided, finance, business, journalism, secondary education—English, and pharmacy. However, undergraduates remain officially undeclared majors during their first year of college.

3.2. Data collection

Three data collection methods were used to determine the relationship between aspects of undergraduates' epistemological beliefs, reflective judgment, and their information-seeking behavior: (1) the MER, a short-essay questionnaire, assessed the level of epistemological beliefs; (2) interviews described information-seeking behavior; (3) reflective judgments were measured using transaction log and verbal protocol analyses of Web and online public access catalog (OPAC) searching using tasks from the RJI. Multiple methods provided triangulation.

- First, undergraduates completed the MER, a short-essay, paper and pencil, questionnaire designed to assess epistemological beliefs (i.e., how people view and construct knowledge) in six domains: the roles of the learner, instructor, peers, evaluation in learning, the nature of knowledge, and decision-making. The average scores on the six domains comprise the final score. Essays are scored using a rating manual (Taylor, 1983). The MER took approximately one hour to complete.
- Then, the undergraduates' were asked to describe their information-seeking behavior during their first semester in college. The interviews lasted on average for approximately 20–30 min.
- Finally, King and Kitchener (1994) designed an instrument to assess an undergraduate's level of reflective judgment. This instrument, RJI, contains four dilemmas with two opposing viewpoints. Individuals are interviewed for approximately 45–60 min about what view they believe in and are asked to justify their beliefs. After the interviews are transcribed, trained raters score the interviews.

Instead of interviewing the undergraduates, two dilemmas were selected from the RJI and undergraduates were asked to search digital environments for information sources that would be useful for supporting their viewpoint in order to determine how they make reflective judgments. Prompts included asking the undergraduates questions such as: Why did you choose this information source? and how do you know that this is a good information source? Undergraduates were encouraged to talk aloud about the decisions they were making while searching the Web and the OPAC. Undergraduates' search logs and verbalizations were captured using Lotus ScreenCam software. Due to technical problems data were not available for three of the 15 subjects.

3.3. Data analyses

Data analyses consisted of three steps: (1) scoring the MERs, (2) transcribing and coding the interviews, (3) analyzing and coding the verbal protocols and transaction logs.

First, the MERs were scored by reading the responses to the entire questionnaire and then trying to establish the central reasons behind the responses for each of the six domains. Each domain section began with a broad question, for example, the role of peers domain began with the question, "Do you prefer classes in which the students do a lot of talking, or where students don't talk very much?" Then the undergraduates are asked to state why they selected the degree of student involvement that they did and what were the advantages and disadvantages of their choice. The other domains followed the same structure. Table 2 describes the relationship between each stage of knowing and the domains. This table was used for determining the stages of epistemological beliefs.

Both the principal investigator and an undergraduate research scholar scored the MERs. Eleven subjects were scored as absolute believers. The four remaining subjects were scored as transitional believers. Table 3 describes the subjects and their level of epistemological beliefs.

The second step of the data analysis included transcribing and coding the interview audiotapes. Data analysis consisted of seeking evidence of undergraduates' epistemological development levels through the content analysis of interview data and the verbal protocols. This method of data analysis consists of several stages: (1) defining the recording units, (2) defining the categories, (3) testing coding on sample of text, (4) assessing accuracy and reliability, (5) revising the coding rules, (6) returning to step three, (7) coding all the text, and (8) assessing achieved reliability or accuracy (Weber, 1990). The analyses of the interview data provided additional evidence to support the initial determination of undergraduates' epistemological belief levels.

This section focuses upon two pivotal interview questions about information-seeking behavior designed to assess undergraduates' epistemological development. The first pivotal question was *how did you determine the usefulness of the information that you encountered?* One undergraduate said, "I really don't trust the Web on points of view, because it's just people's perspectives" (Subject #1). Another undergraduate stated, "Usually I go to the first 10 or 20 sites that pop up, they tend to be ones that are related to the issue. I also look at who it was published by" (Subject #3).

Other undergraduates' used techniques that they learned about how to evaluate Web resources:

> "I would look at the URL to see if the name of the URL is actually somewhat pertinent to the topic, to the information that it's giving out or if the people who are writing the paper can actually back up their information, their knowledge, with like a certain degree or like some sort of academic standing that is related to the topic or whatever it is that the website is about" (Subject #5).

Or, "First I looked for a .org or .gov you can trust but don't really trust them. I look at the information, if I find the information on other websites then I will learn to trust them" (Subject #15).

In terms of looking at print resources, an undergraduate said, "I look at where they (information encountered) are from, names, author, publisher" (Subject #6). Additional methods

Table 2
The epistemological reflection model

Domains	Absolute knowing	Transitional knowing	Independent knowing	Contextual knowing
Role of learner	*Obtains knowledge from instructor	*Understands knowledge	*Thinks for self *Shares views with others *Creates own perspective	*Exchanges and compares perspectives *Thinks through problems *Integrates and applies knowledge
Role of peers	*Share materials *Explain what they have learned to each other	*Provide active exchanges	*Share views *Serve as a source of knowledge	*Enhance learning via quality contributions
Role of instructor	*Communicates knowledge appropriately *Ensures that students understand knowledge	*Uses methods aimed at understanding *Employs methods that help apply knowledge	*Promotes independent thinking *Promotes exchange of opinions	*Promotes application of knowledge in context *Promotes evaluative discussion of perspectives *Student and teacher critique each other
Evaluation	*Provides vehicle to show instructor what was learned	*Measures students' understanding of the material	*Rewards independent thinking	*Accurately measures competence *Student and teacher work toward goal and measure progress
Nature of knowledge	*Is certain or absolute	*Is partially certain and partially uncertain	*Is uncertain—everyone has own beliefs	*Is contextual; judge on basis of evidence in context

From: Baxter Magolda (1992, p. 30).

include, "I usually look for information that is 'scholarly'... The length (of the article) usually determines it. We were given a sheet to tell us what is scholarly and what is not" (Subject #8) or "I just kinda looked at the title to see if it was a reliable journal or not and by the way they (the author) wrote. You can tell if it is more informative. If they have other people cited at the end, I knew it was more reliable" (Subject #10). Another undergraduate mentioned looking for a copyright date.

Two absolute believers selected information consistent with their existing viewpoints including the following, "[I chose] what was close to support my arguments" (Subject #9) or "I eliminated anything that went against my viewpoint" (Subject #14). Others were more discerning including one undergraduate who found a paper on the Web that was exactly about his topic but discovered that it was another student's midterm paper and decided "you don't know if the stuff is right" (Subject #11).

Table 3
The subjects and their levels of epistemological beliefs and reflective judgment

Subjects	Gender	Proposed academic discipline	Epistemological beliefs level	Reflective judgment level
1	Female	Kinesiology	Absolute believer	No data available
2	Male	Undecided	Absolute believer	No data available
3	Female	Civil & Environmental Engineer	Absolute believer	Pre-reflective thinker
4	Male	Biomedical Engineering	Absolute believer	Quasi-reflective thinker
5	Male	Computer Engineering	Absolute believer	Pre-reflective thinker
6	Male	Accounting	Transitional believer	Pre-reflective thinker
7	Female	Communication	Transitional believer	Quasi-reflective thinker
8	Female	Undecided	Absolute believer	Quasi-reflective thinker
9	Male	Finance	Absolute believer	Pre-reflective thinker
10	Female	Business	Transitional believer	Pre-reflective thinker
11	Male	Undecided	Absolute believer	No data available
12	Female	Journalism	Absolute believer	Pre-reflective thinker
13	Female	Education	Absolute believer	Quasi-reflective thinker
14	Female	Pharmacy	Absolute believer	Pre-reflective thinker
15	Female	Chemical Engineering	Transitional believer	Quasi-reflective thinker

The second pivotal question was *what did you do if you encountered information that conflicted with each other or with your own point of view?* An absolute believer asked an authority figure for assistance, "I talked to my professor to see what he thought about it" (Subject #1). Others welcomed conflicting information, "I feel like I had to put it (the opposing viewpoint) in my paper and try to associate it somewhat" (Subject #2), or "I try to incorporate that information (opposing viewpoint) into my argument" (Subject #7) or "I usually explain it (opposing viewpoint) in my paper. I just don't disregard it and not use it. I explain why or why not that information works for me" (Subject #6) and "I would put it in my paper too because you can't really give one side. You will have to give the opposite side too" (Subject #9).

A few undergraduates reported that their viewpoints changed based upon the information that they encountered while searching, "Usually we have to report both (viewpoints). Sometimes it (opposing viewpoints) does change my viewpoint" (Subject #3) or

> "Well, I'd still use it just because again you have got to know both sides, especially when you are doing counterargument papers, you have to know both sides of an issue very well before really just giving a clear, concise defense to your position, to your side and in the process you can probably end up switching to the other side. That tends to happen very commonly. I found that I have started to lean towards a different side" (Subject #5).

Another student had one stance on the subject of human cloning but was persuaded by the information that she encountered to modify her position. Another student changed her opinion about the effect of television violence on children.

Other undergraduates did more than just acknowledge opposing viewpoints. They argued against the opposing viewpoints and described why their views were correct, "I used it too.

I thought 'okay, well this is somebody else's view, how would I respond to that' and I actually use that method to lengthen my paper and add to my paper'' (Subject #8) or ''I just incorporated it into my paper and I just found ways to disagree with their point of view and to find weaknesses'' (Subject #10). A faculty member suggested that an undergraduate use this technique too, ''Our English instructor encouraged us to incorporate it into it (the paper) and to tell our point of view and to switch it around and we would show how that evidence wasn't necessarily as strong as other people would want you to believe it was'' (Subject #12). However, an absolute believer eliminated conflicting information, ''I didn't use books that were totally opposite of what I agreed with'' (Subject #14).

The third step of data analyses consisted of analyzing and coding the searching behavior of the undergraduates by examining both the verbal protocol and transaction logs to determine their reflective judgment level (i.e., pre-reflective, quasi-reflective, or reflective). The first task statement from the RJI was, ''Most historians claim that the pyramids were built as tombs for kings by the ancient Egyptians, using human labor, and aided by ropes, pulleys, and rollers. Others have suggested that the Egyptians could not have built such huge structures by themselves, for they had neither the mathematical knowledge, the necessary tools, nor an adequate source of power.'' Analyses consisted of examining undergraduates' verbalizations as they explained how they made judgments about the authority of the Web sites they encountered or the information sources they found while searching the OPAC. Undergraduates who had difficulty assessing the authority of various information sources were scored as pre-reflective thinkers while those who could articulate criteria for assessing authority were scored as quasi-reflective thinkers. None of the subjects were scored as reflective thinkers, seven were scored as pre-reflective thinkers, and five were scored as quasi-reflective thinkers. Table 3 also describes the subjects and their levels of reflective judgment.

Most of the undergraduates assessed the Web pages that they encountered by reading the titles and abstracts from a list of ''hits.'' Others immediately selected the first hit because they believed that the search engine would place the most relevant hits first. Some undergraduates looked at the URL for the page to determine if it was an .edu or .gov. A pre-reflective thinker examined the website to ''see who it's published by'' although she also stated that a user should ''go with what your instinct is'' or if ''they seem to know what they are talking about'' (Subject #3). Many students were more skeptical, ''I don't know if this is a good site because some people put any old thing on there (the Web).'' He rejected a site that he found because ''it doesn't seem scholarly'' (Subject #9). Many undergraduates judged the authority of a Web site by whether or not a name was attached to the site, for example, a pre-reflective thinker stated, ''if someone is willing to put their name out there, then they obviously did some more research'' (Subject #12) or other pre-reflective thinkers have said, ''...it has the person's name at the bottom'' (Subject #10) or ''this one (Web site) seems like it's a good one because it has the author's name on it.'' When the interviewer asked the undergraduates if they knew whom the authors were or how did they know that the author was legitimate they admitted that they did not know although the second undergraduate quoted above looked for additional information such as the affiliation of the author via the e-mail address that contained an .edu. Other undergraduates recognized trusted names as producers of certain sites like PBS, National Geographic, etc., for example, a quasi-reflective thinker said, ''well NOVA tends to be a good one (Web site)'' (Subject #7) or another quasi-reflective thinker, ''NOVA has something for sure'' (Subject #8). One undergraduate thought a

Web site was good because it contained a lot of diagrams. Another concluded that searching the Web was a lot like gambling, a site had "a 50% chance of being actual factual." One pre-reflective thinker rejects a Web page that had a name attached to it because "right now it looks like a pretty random Web page." He also noticed that the site had a "see my guestbook" link that made it appear to not be a legitimate site. However, he allows the search engine to decide the authority of the Web sites, "usually I try to use what comes up first because I think they try to give you the most valid first."

The second RJI task statement was "There have been frequent reports about the relationship between chemicals that are added to foods and the safety of these foods. Some studies indicate that such chemicals can cause cancer, making these foods unsafe to eat. Other studies, however, show that chemical additives are not harmful, and actually make the foods containing them more safe to eat."

It was apparent to the principal investigator that the subjects had more experience searching the Web than the OPAC. Many made statements like "I've only used this once or twice" in reference to the OPAC. Several of the undergraduates confused the OPAC with searching journal indexes. They repeatedly tried to find an abstract for the book on the OPAC which does not contain abstracts for books. They also selected an information source without looking at the date of publication or the publisher including a transitional believer/quasi-reflective thinker who selected a book published in 1898 and an undergraduate who selected a proceeding from a conference in the former Czech Republic to answer a search task. Most selected a book if the title contained their selected keywords regardless of who the authors or publishers were. Perhaps the undergraduates were allowing the collection development librarians to make the decision about the authority of the information sources in much the same way that one of the undergraduates in a previous example believed that the search engine listed the most valid Web site first. An absolute believer/quasi-reflective thinker exhibited the same information-seeking behavior using the Web and the OPAC. He selected the first item on a list of items regardless of how relevant it was for his task believing that the first item was the most valid. A transitional believer/quasi-reflective thinker did look at who was publishing a document, "this one has Technical Support Series from the World Health Organization so I would think that that would be pretty scholarly" (Subject #7).

After conducting separate data analyses, data from all three steps were analyzed to determine if there was a relationship between undergraduates' epistemological beliefs, reflective judgment levels and their information-seeking behavior.

4. Discussion

The main focus of this study was investigating the relationship between undergraduates' epistemological beliefs, reflective judgment and their information-seeking behavior. The following section describes the findings.

The first research question was, what are undergraduates' epistemological beliefs and reflective judgments? The results of data analyses revealed that eleven subjects were categorized at the first level of epistemological beliefs—absolute believers and four subjects were classified at the second level—transitional believers. These same subjects were classified into two categories of reflective judgment levels. Analyses were only available for twelve of the original fifteen subjects since data

were lost. Of the twelve remaining subjects, seven were categorized at the first level—pre-reflective thinkers while the remaining five subjects were categorized at the second level—quasi-reflective thinkers.

The next research question was, is there are relationship between epistemological beliefs and reflective judgments? The answer is inconclusive. Five subjects were categorized at level one for both epistemological beliefs and reflective judgment while two subjects were classified at the level two for both measures for a total of seven of the twelve subjects or 58%. There were inconsistencies between the categorization of five subjects (42%). Three absolute believers (level one) were assessed as quasi-reflective thinkers (level 2) while two transitional believers (level 2) were assessed as pre-reflective thinkers (level 1). As described in the theoretical framework, both models of epistemological development measure different elements and this is reflected in these findings. The measure of epistemological reflections examines how individuals' epistemological beliefs are used to make sense of the college environment while the reflective judgment model examines how epistemological beliefs are used to make judgments about ill-structured problems—problems that have no right or wrong answers.

The third research question was, do epistemological beliefs and reflective judgment affect information-seeking behavior? Absolute believers selected information sources consistent with their own views and rejected information sources that were in opposition to these views. One possible explanation for this behavior could be the concept of confirmation bias (Schulz-Hardt, Frey, Luthgens, & Moscovici, 2000). Confirmation bias means people prefer information that supports their views rather than conflicting information. Additionally, absolute believers asked authority figures such as faculty for help to determine the authority of sources when they encountered conflicting information sources instead of determining the usefulness of these sources based upon their own ability. Transitional believers used criteria to evaluate Web sources including examining the URL of a Web site, assessing the institutional affiliation of the author of the site, looking at the publisher of a print source, etc. These undergraduates welcomed conflicting information. They often felt that including this information in their paper and providing counterarguments strengthened their academic assignments.

There was also a relationship between reflective judgment and information-seeking behavior. Pre-reflective thinkers often selected the first "hits" selected by the search engines thereby allowing the search engines to make judgments about the relevancy and quality of the information source. These pre-reflective thinkers did not use a lot of criteria for judging Web sites. Some looked at sites to determine if a name was attached to the site but did not try to determine the credibility of the author of the site. While examining traditional print sources found on the OPAC these pre-reflective thinkers often used keywords in the title as their selection criteria without considering the date of publication, the author's or publisher's credentials, etc. At least one undergraduate exhibited the same type of behavior in both digital environments. He selected the first "hit" from a list of possible information sources on the OPAC and the Web as the most relevant hit. Quasi-reflective thinkers looked at the URLs of Web sites to determine if the site was generated by a .gov or .edu organization, were more skeptical of the information encountered on the Web, and could recognize legitimate and authoritative sites.

Although the study by Whitmire (in press) did not examine the relationship between reflective judgments and information-seeking behavior it did examine the relationship between episte-

mological beliefs and information-seeking behavior. This study was consistent with Whitmire (in press) by finding that more advanced epistemological believers were better able to evaluate information sources and recognize authority. Although, the study by Rieh (2002) used faculty and doctoral students as subjects and this study used undergraduates, both groups used similar criteria for establishing the authority of the information encountered on the Web such as the URL domain, and reputation of the website. However, the subjects of this study did not explicitly mention many of the criteria included in the Wathen and Burkell (2002) model such as the appearance/presentation, usability/interface design or organization of information.

5. Conclusion

This study has both theoretical and practical implications. Theoretically, this study contributes to the growing body of studies examining how users make judgments about the information encountered in digital environments while focusing on the role of epistemological beliefs and reflective judgment. Practically, reference librarians in academic libraries can help undergraduates develop epistemologically by encouraging them to use information sources that contain viewpoints that differ from their own views and by assisting them to make reflective judgments about the credibility and authority of the information sources they encounter both on the Web and on OPACs by establishing criteria to use for analyses.

Future research would benefit from the inclusion of less obtrusive data collection techniques. For example, instead of using think alouds as the verbal protocol method, other researchers may want to use think afters in conjunction with the transaction logs because the subjects in this study seemed uncomfortable about being observed. Both methods have distinct advantages and disadvantages (Branch, 2000). Future studies could also include other online retrieval systems such as indexes to journal articles and other library databases. Finally, additional analyses of disciplinary differences and citations like the work of Hjorland (2002) would further extend this area of investigation by measuring the impact of academic discipline on epistemological beliefs and reflective judgment.

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Appendix A. Interview questions

Please think about your experiences from this semester about seeking information to complete course assignments...

1. What types of courses required you to seek information in order to complete course assignments?
2. What types of course assignments required you to seek information?

Think about a major assignment that required looking for a great deal of information... What was the assignment?

3. Please describe your information-seeking process. How did you go about seeking information?
4. How did you determine the usefulness of the information that you encountered?
5. What did you do if you encountered information that conflicted with each other or with your own point of view?
6. What role did your instructors/faculty play in your information seeking process?
7. What role did your fellow students play in your information seeking process?
8. What role did academic library and/or academic librarians play in your information-seeking process?
9. Are you satisfied with your current methods of seeking information? If not, what would you like to change about your information-seeking process?
10. Is there anything else that you would like to add?

References

Baxter Magolda, M. B. (1992). *Knowing and reasoning in college: Gender-related patterns in students' intellectual development*. San Francisco: Jossey-Bass.

Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice, and mind*. New York: Basic Books.

Branch, J. L. (2000). Investigating the information-seeking processes of adolescents: the value of using think alouds and think afters. *Library and Information Science Research, 22*, 371–392.

Elmborg, J. K. (2002). Teaching at the reference desk: Toward a reference pedagogy. *Portal: Libraries and the Academy, 2*(3), 455–464.

Hjorland, B. (2002). Epistemology and the socio-cognitive perspective in information science. *Journal of the American Society for Information Science and Technology, 53*(4), 257–270.

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67*(1), 88–140.

King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. San Francisco: Jossey-Bass.

Perry, W. (1999). *Forms of intellectual and ethical development in the college years: A scheme*. San Francisco: Jossey-Bass.

Rieh, S. Y. (2002). Judgment of information quality and cognitive authority in the Web. *Journal of the American Society for Information Science and Technology, 53*(2), 145–161.

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498–504.

Schommer-Aikins, M., & Hutter, R. (2002). Epistemological beliefs and thinking about everyday controversial issues. *The Journal of Psychology, 136*(1), 5–20.

Schulz-Hardt, S., Frey, D., Luthgens, C., & Moscovici, S. (2000). Biased information search in group decision making. *Journal of Personality and Social Psychology, 78*(4), 655–669.

Taylor, M. B. (1983). *The development of the measure of epistemological beliefs*. Unpublished doctoral dissertation, Ohio State University.

Wathen, C. N., & Burkell, J. (2002). Believe it or not: Factors influencing credibility on the Web. *Journal of the American Society for Information Science and Technology, 53*(2), 134–144.

Weber, P. R. (1990). *Basic content analysis* (2nd ed). Newbury Park, CA: Sage.

Whitmire, E. (in press). Epistemological beliefs and the information-seeking behavior of undergraduates. *Library and Information Science Research*.

Wilson, P. (1983). *Second-hand knowledge: An inquiry into cognitive authority*. Westport, CT: Greenwood Press.