SCIENCE AND HEALTH WEB INFORMATION UTILIZATION: AN INVESTIGATION INTO KNOWLEDGE BUILDING BY EVERYDAY LIFE INFORMATION SEEKERS

by

NORA J. BIRD

A Dissertation submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Communication, Information and Library Studies

Written under the direction of

Dr. Claire R. McInerney

and approved by

____

____

____

____

New Brunswick, New Jersey

January, 2008

ABSTRACT OF THE DISSERTATION

Science and Health Information Utilization on the Web: An Investigation into Knowledge Building by Everyday Life Information Seekers

By NORA J. BIRD

Dissertation Director:

Claire R. McInerney, Ph.D.

Two studies examined information utilization by adult everyday life information seekers in the context of science and health information. A coding scheme developed by Todd (2006) was applied to a one group pre-test post-test protocol where Web users served as their own controls in non-random groups and were asked to describe the knowledge that they have about one of two topics: genetically modified food in the first study and food safety concerns in the second study. After Web searching and choice of sites, they were asked to state what they knew about the topic again. The coding structure was used to compare the before and after statements as to structure, accuracy, and extent of knowledge. In addition, an instrument devised by McInerney (2000) and refined by further research (McInerney & Bird, 2005) was used by the participants to judge the quality of the Web resources that they encountered. Web quality factors included in the tool were investigated to see which, if any, helped the participants build knowledge structures.

In both studies, there was an increase in the total number of relational statements made by the participants at the post-test stage. The increases were in both Facts and Implications type statements. The detected knowledge structure changes mirrored an increase in the extent of topic knowledge, but accuracy actually decreased or stayed the same. In the first study, University affiliates produced significantly more total relational statements on the post-test. In the second study, participants who had more food preparation experience and were more educated produced more Implications statements than other groups. Only the graphics quality ratings were shown to have an effect on quantity of relational statement production in the first study. In the second study, utilization of low quality rated Websites was associated with production of Facts statements, while high quality Websites was associated with Implications statements. Credibility and overall quality were correlated with each other in the second study. Results suggest avenues for future research.

ACKNOWLEDGEMENTS

There are many people to whom I owe thanks for their help in completing this work. A select few are included here. To the countless others, a general thank you for everything that you did.

I would like to thank my adviser, Claire McInerney, for her constant inspiration and assistance. Her work with me is the true definition of mentorship. I am forever grateful.

Each committee member, Dr. Ross Todd, Dr. Marie Radford, and Dr. Jannica Heinström, contributed their expertise when needed. Special thanks go to Dr. Todd for sharing the keys to information utilization.

The Rutgers University Food Policy Institute provided funding from the United States Department of Agriculture, space, and expertise to help me complete this research. Thanks are owed to all of the staff and to the director, Dr. William Hallman, for their support.

The cohort of people that began the program with me has made an invaluable contribution to my ideas and my sanity. Special thanks to Mary, Dawn, Andrea, and Stew for their constant friendship. Thanks also to Cathy, Bo, Andy, and William, who worked beside me on many aspects of these research projects.

The work could not have been done without the volunteer participants, who gave their time to complete the protocols for only a small remuneration. I thank them and I hope that this work accurately reflects their contribution.

The SCILS staff provided much help along the way. Special consideration is owed to Joan Chabrak for her guidance and insight. Thanks also to the Dean's Office staff and to CISSL for their help.

None of the work could have been accomplished, though, without the dedication of my spouse and life partner, Robert Cary. There are not enough words to express my gratitude.

DEDICATON

My dissertation is dedicated in memory of my father, William T. Bird, and my brother, Thomas M. Bird, whose untimely deaths set me on a journey to complete this dream. Their presence is embodied through the encouragement of my mother, Gloria Bird, and my brother and sisters.

TABLE OF CONTENTS

ABSTRACT OF THE DISSERTATION ii
ACKNOWLEDGEMENTS iv
DEDICATON vi
TABLE OF CONTENTS vii
LIST OF TABLES xii
LIST OF ILLUSTRATIONS xiii
CHAPTER 1: INTRODUCTION AND THEORETICAL FRAMEWORK 1
1.1 Introduction 1
1.2 Theoretical Framework 1
1.3 Topical Domain 3
1.4 Problem Statement 4
1.5 Conceptual Model and Research Questions 5
CHAPTER 2: LITERATURE REVIEW 9
2.1 Introduction 9
2.2 Information Seeking 11
2.2.1 Everyday Life Information Seeking 11
2.2.2 Information Seeking Activities: Seeking and Selecting Information 12
2.2.3 Summary 15
2.3 Science Knowledge and Information Seeking 16
2.3.1 Introduction 16
2.3.3 Cognitive Authority and Science 19
2.3.4 Science Information Seeking Behavior 20
2.3.5 Specific Contexts: Genetically Modified Food and Food Safety 22
2.3.6 Summary 23
2.4 Information Quality Analysis 24
2.4.1 Introduction 24
2.4.2 Characterizing the Web and Web Resources 24
Technology issues. *25*
Search engines. *26*

2.4.3 METHODS OF INFORMATION QUALITY ANALYSIS 27

Expert content evaluation 27

Quality checklists 28

User studies. 29

2.4.4 SUMMARY 30

2.5 Information Utilization and Knowledge Change Assessment 30

2.5.1 INTRODUCTION 30

2.5.2 THE FUNDAMENTAL EQUATION 31

2.5.3 KNOWLEDGE CHANGE ASSESSMENT 32

2.5.4 DECLARATIVE KNOWLEDGE CHANGE 32

2.5.5 SUMMARY 35

CHAPTER 3: METHOD 36

3.1 Introduction 36

3.2 Method Overview 36

3.3 Study 1: Information Utilization within a GM Food Context (GMFC)................ 39

3.3.1 INTRODUCTION 39

3.3.2 PARTICIPANTS 41

3.3.3 PROCEDURES 41

Equipment 41

Tasks. 42

Instruments 42

3.4 Study 2: Information Utilization within a Food Safety Context (FSC) 43

3.4.1 INTRODUCTION TO THE FOOD SAFETY CONTEXT STUDY 43

3.4.2 PARTICIPANTS 46

3.4.3 PROCEDURES 47

Equipment. 47

Tasks. 47

Instruments. 48

3.5 Data Analysis 50
3.5.1 INTRODUCTION 50
3.5.2 KNOWLEDGE STRUCTURE CODING 51
3.5.3 METACOGNITIVE STATEMENTS, ACCURACY, AND EXTENT 54
3.5.4 DETERMINING THE TREATMENTS USED 56
3.5.5 DESCRIBING CHANGES IN RELATIONAL STATEMENTS 57
3. 6 Method Limitations 58
CHAPTER 4: RESULTS OF THE INFORMATION UTILIZATION IN GENETICALLY MODIFIED FOOD CONTEXT STUDY 60
4.1 Introduction 60
4.2 Participants 60
4.3 The Treatments – Websites Chosen and Rated 60
4.4 Changes in Knowledge Structures 68
4.5 Knowledge Structure Changes for Participant Groups 70
4.5.1 INTRODUCTION 70
4.5.2 NUMBER OF RELATIONAL STATEMENTS 70
4.5.3 CHANGE IN METACOGNITIVE STATEMENTS 79
4.5.3 ACCURACY OF STATEMENTS 79
4.6 Quality Ratings and Knowledge Structures 82
4.7 Discussion of Findings 84
CHAPTER 5: RESULTS OF THE INFORMATION UTILIZATION IN FOOD SAFETY CONTEXT STUDY 88
5.1 Introduction 88
5.2 Participants 88
5.3 The Treatments – Websites Chosen and Rated 94
5.4 Changes in Knowledge Structures 99
5.4.1 INTRODUCTION 99
5.4.2 INSTRUMENTS USED 99
5.4.3 ANALYSIS 100
5.4.4 RESULTS 103

5.5 Knowledge Structure Changes for Participant Groups 105
5.5.1 Introduction 105
5.5.2 Mean Number of Relational Statements by Demographic Groupings 105
5.5.3 Change in Metacognitive Statements 114
5.5.4 Accuracy of Statements 114
5.5.5 Extent of Topic Knowledge Change 116
5.5.6 Summary 117
5.6 Quality Ratings and Knowledge Structures 118
5.6.1 Introduction 118
5.6.2 Quality and Credibility Assessments Related to Demographics 118
5.6.3 Knowledge Structures Related to Quality and Credibility Assessments 121
5.6.4 Summary 124
5.7 Discussion of Findings 124
CHAPTER 6: CONCLUSIONS AND IMPLICATIONS 128
6.1 Introduction 128
6.2 Knowledge Change 130
6.3 Demographic Effects on Knowledge Change 135
6.4 Relationship between Website Quality and Knowledge Change 137
6.5 Limitations 141
6.6 Implications 142
6.6.1 Revised Conceptual Model 142
6.6.2 Implications for Research 144
6.6.3 Implications for Practice 146
6.7 Future Research Directions 147
APPENDICES 149
Appendix A. Glossary 149
Appendix B. Study 1: Recruiting Information for Study 1 (GMFC) 154
Appendix C. Study 1 (GMFC): Consent Form to Participate in a Research Study 155
Appendix D. Study 1 (GMFC): Pre-searching Knowledge Survey 156

Appendix E. Study 1 (GMFC): Web Search Questions 158
Appendix F. Study 1 (GMFC): Website Evaluation Tool 159
Appendix G. Study 1 (GMFC): Follow-up Questionnaire about Food, Agriculture, and the Environment A Rutgers University Study 160
Appendix H. Study 2 (FSC): Consent Form to Participate in a Research Study............ 164
Appendix I. Study 2 (FSC): Food Safety Web User Pre-Search Questionnaire............. 165
Appendix J. Study 2 (FSC): Food Safety Web Search Scenarios.................................. 169
Appendix K. Study 2 (FSC): Website Quality Evaluation Tool.................................... 171
Appendix L. Study 2 (FSC): Food Safety Web Users' Post-Search Questionnaire 173
Appendix M. Study 2(FSC): Food Safety Web User Follow-Up Invitation 174
Appendix N. Study 2 (FSC): Follow-up Survey after 2 weeks after Searching............. 175
Appendix O. Code Book for Knowledge Structure Coding 177
REFERENCES 181
CURRICULUM VITA 191

LIST OF TABLES

Table 3.1 Overview of Genetically Modified Food Context (GMFC) Study Relating Research Questions to Participants, Instruments, and Analysis 40

Table 3.2 Selected Demographics for the Participants in GMFC.................................... 41

Table 3.3 Overview of the Food Safety Context (FSC) Study Relating Research Questions to Participants, Instruments, and Analysis 45

Table 3.4 Selected Demographics for the Participants in the FSC 47

Table 4.1 The Twelve Web Objects Most Often Rated by the Study Participants Showing URL and sponsor 62

Table 4.2 Top Level Domains of the 82 Websites Chosen by the GMFC Participants ... 63

Table 4.3 Median WQET Ratings for the Top Five Most Often Rated Websites 67

Table 4.4 Number of Explicated Statements (Relational and Metacognitive) 69

Table 5.1 The Five Websites Most Often Rated by the Participants Showing URL and Sponsor 96

Table 5.2 Top Level Domains of the 39 Websites Chosen by the FSC Participants........ 96

Table 5.3 Examples of Relational Statement Coding from the FSC 102

Table 5.4 Number of Explicated Statements (Relational and Metacognitive) 104

Table 6 Summary of Major Findings Related to the Research Questions 129

LIST OF ILLUSTRATIONS

Figure 1. Conceptual model of the two studies showing the everyday life information seeker before and after the use of Web resources. 8

Figure 2. Schematic representation of major concepts presented in the literature review 10

Figure 3. Summary of knowledge structure codes used in the analysis. 52

Figure 4.1. Boxplot of median participant Website ratings on all seven characteristics on the WQET. 65

Figure 4.2. The mean number of relational statements explicated by females and males on both the Pre-search and Follow-up instruments.. 72

Figure 4.3. Mean number of relational statements made by the participants on the Pre-search and Follow-up separated by age group. 73

Figure 4.4. Participant education levels and the mean number of relational statements at Pre-search and Follow-up stages. 75

Figure 4.6. Boxplot showing the range in the total number of relational statements made by university and non-university affiliates on the Follow-up instrument................ 78

Figure 4.7**.** Percentage of statements in each accuracy category on the Pre-search and Follow-up. 80

Figure 4.8. Extent of participant topic knowledge on the Pre-search and Follow-up. 81

Figure 5.1. Number of participants in each gender group at each stage. 90

Figure 5.2. Percentage of participants in each age group at each stage. 90

Figure 5.3. Percentage of participants who disclosed their educational level and their completion of each stage of the protocol. 91

Figure 5.4. The occupation of the participants is depicted here. 92

Figure 5.5. Food preparation experience of the sample population. 93
Figure 5.6. Boxplot of evaluations of credibility and quality of the entire sample of Websites. 98
Figure 5.7. Mean number of relational statements by type and by gender of the participants. 106
Figure 5.8. Mean relational statements by age groups on Pre-search and Follow-up instruments. 108
Figure 5.9. Mean number of relational statements separated by educational level and type. 110
Figure 5.10. Boxplot of the mean number of Implications statements made by participants from different educational backgrounds on the Follow-up instrument. 111
Figure 5.11. Mean number of relational statements shown by type and occupation of the participant. 112
Figure 5.12. Mean number of relational statements made by participants who reported their experience with food preparation to be rarely, sometimes, frequently, or always. 113
Figure 5.13. Accuracy of explicated statements made by participants is illustrated above. 115
Figure 5.14. Boxplot of food preparation experience is inversely correlated with credibility. 120
Figure 5.15. Relationship between quality and production of Facts relational statements. 122

Figure 5.16. Boxplot showing that participants who rated their Websites as 7 (excellent) produced more Implications statements than those who gave lower ratings.......... 123

CHAPTER 1: INTRODUCTION AND THEORETICAL FRAMEWORK

1.1 Introduction

When asked questions about science, many adults demonstrate that they do not know much (National Science Board, 2002; 2004; 2006). Yet, there are many complex issues in the world that are impacted by the results of scientific inquiry. Pressing policy issues such as global warming, nuclear proliferation, and stem cell research and, more personally, decisions about appropriate health treatments and eating safe food are part of the landscape that surrounds people on an everyday basis. The information sources that adults choose from those available and, more importantly, the way that they use them to build knowledge about matters such as these, are important topics that have had little study. The two studies discussed here use the lens of two contextual topical domains to investigate the way that the knowledge structures of adults change in response to the information resources that they use.

1.2 Theoretical Framework

The studies are based, in part, on the *everyday life information seeking* (ELIS) theory of information behavior (Savolainen, 1995; Savolainen, 2005). The researcher shares the ELIS goal of understanding people in the context of their everyday affairs such as consumer and health related decisions. ELIS research is primarily interested in selection of resources and uses discourse analysis as one of its research tools. The method used here is based in the cognitive perspective that sees information seeking and utilization as being mediated by a system of concepts and categories (Ingwersen, 1992; 1996).

The cognitive perspective has many information seeking models. The present research is based partially on the anomalous state of knowledge (ASK) theory postulated by Belkin (1980, 2005). He writes that when a state of inadequate knowledge is identified, information will be sought to satisfy a goal. Belkin and others showed that when asked, people could describe what they knew and didn't know and what search terms could be used to find information sources (Belkin, Oddy, & Brooks, 1982). These search terms could be used as the basis for information retrieval; the results of these studies informed the design of systems.

Quality of information sources is another concern in these studies. One major aspect of this dimension is the *cognitive authority* that the source may have for the individual using it (Wilson, 1983). The recognition of credibility and the influence that a source has upon the reader may affect information utilization. Users' assessments of cognitive authority may change the knowledge structures that are built after the use of information sources.

The fundamental equation proposed by Brookes (1980a, 1980b, 1980c) is one foundation of this inquiry. This pseudo-equation is more philosophy than an empirical mathematical formula, but it sums up the ideas that inform the present work. The equation indicates that personal knowledge structures are changed when they encounter information sources. Todd (1999a) refined Brookes's work and defined the concept of *information utilization* as a description of the activity done with the content of an information *source*. Todd (1999b) empirically studied and described the ways that adolescent girls utilized new information about heroin. Analyzing their written and spoken discourse, he created concept maps of their prior knowledge structures and then those that existed after exposure to new information. He shows that the knowledge structures were changed (Todd, 1999b; Todd, 2005).

1.3 Topical Domain

Information utilization must be studied within a particular topical context. For this dissertation, the context can be broadly described as food safety, a topic that is both science and health related. Science information can be viewed as *public knowledge* that has been passed through a number of gatekeepers (Wilson, 1977; Ziman, 1968; 1978; 2000). Although these cumulated ideas are available to many, they are still *second-hand* because few of the lay public are involved in scientific research. What lay people do know may have been learned in school, and there is evidence that this learning is not always complete (Hand, Alvermann, Gee, Guzzetti, Norris, Philips, 2003). Many surveys show that people cannot answer basic science fact questions (Miller, 1986; National Science Board, 2002; 2004). The conventional wisdom in science education and communication is that only the availability of correct information will lead to increased scientific literacy. Yet, work in knowledge change assessment shows that even in curriculum-based school situations where motivation might be considered to be high, knowledge change in response to correct science information is problematic. A review of the use of anomalous data to challenge students' pre-conceptions of science theories showed that complete acceptance of the generally accepted science theory was only one of seven responses that students made to the newly demonstrated data (Chinn & Brewer, 1993). An example of the other six responses is that some students would describe the new data to fit their own theory.

The situation for adults separated from school has rarely been studied, except by national surveys as described above. Yet, the importance of having high quality information about science and health cannot be overemphasized. Decisions about whether to support the cultivation and distribution of genetically modified (GM) food, products that are considered dangerous by some, is one particular case that involves the utilization of information to build understanding about the available choices. The selection and utilization of information about food safety is similar but involves questions about how to handle proven dangers, such as foodborne illnesses, rather than those that have been merely conjectured about or might happen in the future, as problems with GM food might be described.

1.4 Problem Statement

The *knowledge structures* that lay adults create about unfamiliar topics such as food safety from sources that they find and choose themselves is the focus of this inquiry. This topic has gained new importance with so many resources now available immediately on the Web with few gatekeepers or assistants to find, organize, and recommend them. Much work has been done on supporting the choice of Web resources, but information utilization, or the activity that happens after the choice, is rarely studied. The present research examined utilization by analyzing the knowledge structures that are built after use of chosen Web resources. It used a framework developed for students in a curriculum exercise (Todd, 2006) and applied it to an adult everyday life information use situation. The two studies used a repeated measures approach that provides hypothetical scenarios to prompt the searching for Web information. The focus is on the statements made about the topic before and after participants' interaction with resources that they choose to use and evaluate.

Choice of a source implies that some determination of its quality has been made. Information utilization, however, may indicate something further; that the chosen source has cognitive authority for the reader. Cognitive authority (Wilson, 1983) includes both a judgment of credibility of the information and the fact that it will influence further use by a reader. Determining how Web users award cognitive authority to resources and the effect that this judgment may have on subsequent knowledge structures is an important question for librarians hoping to build authoritative library collections. It is hoped that understanding the factors that lead to a determination of quality and subsequent use will inform the building of better informational Websites and digital libraries.

The interrupted time series design, rarely seen in Information Science (Julien & Duggan, 2000), makes it possible to study the utilization of potentially critical information in everyday life situations. The participant population is beyond the academy walls where there exists wide variation in prior knowledge about the topics, ability to use the Web, and academic preparation. If, and possibly, how these demographic variants impact the formation of new knowledge structures is an important focus of study.

1.5 Conceptual Model and Research Questions

The understanding of how everyday life information seekers build knowledge from Web resources can be improved by adopting an information utilization approach. By focusing on the change in individuals over time, knowledge structure building can be described. Relationships to personal variables and the quality of the sources may influence knowledge structures. These concepts can be summarized in the model for the two studies shown in Figure 1. The main difference between the studies is in topical focus. The context for Study 1 was genetically modified food and that for Study 2 was food safety information.

The model depicts the everyday life science or health information seeker before and after use of Web resources. Characteristics that may influence initial topical knowledge are shown including Rutgers University affiliation, education level, gender, and age. Occupation and food preparation experience were other factors that were added to the second study. Explicated knowledge of genetically modified (GM) food or food safety was recorded before selection of Web resources. The selected resources were evaluated for quality issues such as functionality, content, and credibility. Then, new explicated knowledge was assessed at the end of the session (Study 2 only) and two weeks later (both studies).

The following research questions are suggested by the conceptual model:

RQ1. How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about a) genetically modified food or b) food safety?

RQ2. In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?

RQ3. How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all?

In order to clarify the terms used above and throughout the rest of this dissertation, a glossary is presented in Appendix A. A literature review will be found in the second chapter. Chapter three outlines the methods that were used for data collection and analysis in both dissertation studies. Chapter four discusses the first protocol that focused on information utilization in the context of genetically modified food. Chapter five presents the analysis of the second protocol that examined the use of food safety information. The sixth and final chapter will provide a general discussion of the two studies' results and conclusions and implications.

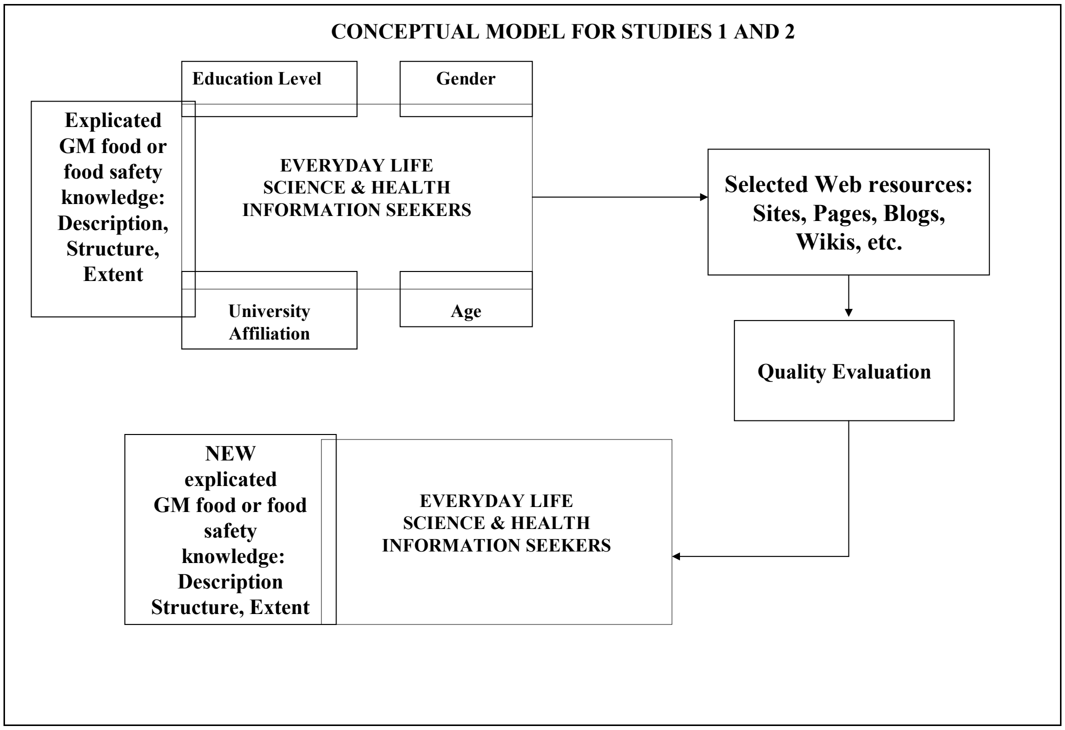


Figure 1. Conceptual model of the two studies showing the everyday life information seeker before and after the use of Web resources.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A schematic of the relationship between major concepts used in this research is presented in Figure 2. Each bolded concept in the schematic is a separate section in the following literature review. The first section of the review will explain the background to everyday life information seeking. For the purposes of this study, it is assumed that some people at some time will engage in science or health information seeking activities. It is the information behavior of this group of people that is of interest here.

The Web is one possible information channel that everyday life information seekers might choose. If chosen, only some of the sources on the Web will be deemed relevant to the topic. As part of this *relevance* judgment the overall quality of the information presented will be assessed. Some of the large quantity of research on Website quality assessment will be examined. A number of factors are thought to be part of this assessment, including the presentation of the information, i.e., the functionality, graphics and style, and the content of the information, i.e., topicality, coverage and cognitive authority. As shown in the schematic, the awarding of cognitive authority involves a determination of credibility and influence over the reader.

After a source is chosen, the information contained within it may be used to add to existing knowledge structures by way of information utilization (Brookes, 1980a, 1980b, 1980c; Todd, 1999a, 1999b). Further research about information utilization and a concept used in educational psychology, conceptual change, will be detailed in the section on knowledge change assessment.

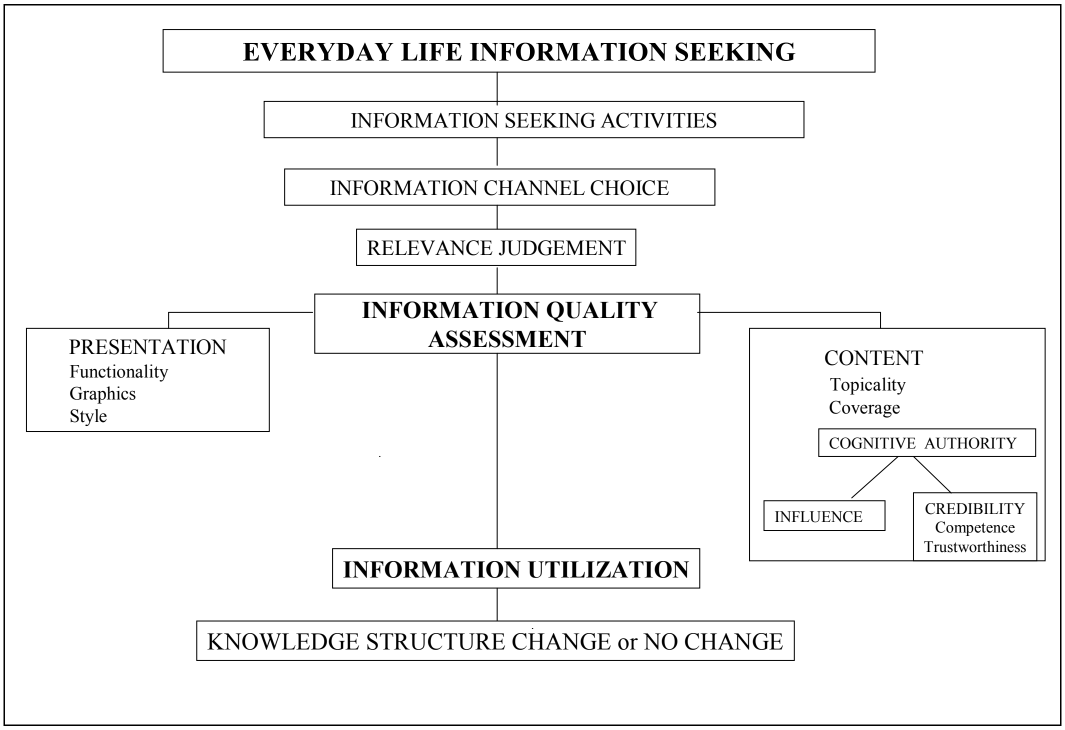


Figure 2. Schematic representation of major concepts presented in the literature review.

2.2 Information Seeking

The world is full of information that people interact with everyday. Only some of that information is searched for and selected for later use. The following section will review selected theoretical perspectives on information seeking activities. The background to everyday life information seeking will be explained first. Then, general concepts from the cognitive perspective of information seeking will be explored.

2.2.1 Everyday Life Information Seeking

The study of *everyday life information seeking* (ELIS) was introduced by Savolainen (1995; 2005), who defines the field in his 1995 work as:

> Broadly defined, the concept of ELIS refers to the acquisition of various informational products (both cognitive and expressive) elements which people employ to orient themselves in daily life or to solve problems not directly connected with the performance of occupational tasks. Such problems may be associated with various areas of everyday life, for example, consumption and health care. (p. 266-267)

In further study of Internet use in a non-work context Savolainen found that in Finland the Internet, in terms of both e-mail and Web use, had been incorporated into everyday life (1999). Recent statistics from a national survey in the United States show that, at least in numbers, the general public has embraced the use of the Internet for everyday use with over 71% of the adult population reporting that they use the Internet (Pew Internet & American Life Project, 2007). The focus in this dissertation is on users engaged in non-work and non-school related tasks aligning it with the general aims of ELIS.

2.2.2 Information Seeking Activities: Seeking and Selecting Information

A first step in gaining or verifying knowledge is to seek and find information that is available to answer a question. This questioning state can be looked at as an Anomalous State of Knowledge (ASK), a cognitive model of information seeking proposed by Belkin (1980; 2005). In ASK-based theories of knowledge representation, people realize that their knowledge is "inadequate" (Belkin, 2005, p.44) and approach information systems to find the information that will help them complete a goal. Belkin, Oddy and Brooks (1982) conducted an empirical study to see if the ASK state could be represented by the statements people made about their perceived needs. Creating "association maps" of the statements, based on the seekers' explicated concepts, the experimenters sought to build information retrieval systems that would better match the intentions of the system's users. The focus of past work based on ASK has been information retrieval rather than utilization; however, one cannot use information that has not been found. It is important to the present investigation that a person can describe what is needed in terms that can be used to search the contents of an information system.

Once a need for information is expressed, it is matched against the available resources. The correspondence between query and resource is described by the fundamental concept *relevance*. Research on relevance has a long history that encompasses many different types and attributes (Cosijn & Ingwersen, 2000; Mizzaro, 1997; Saracevic, 2006, 1996; Schamber, Eisenberg, & Nilan, 1990). The basic premise of relevance is that the results of an information search are evaluated by information seekers, who then choose the material that seems to answer their questions. In other words, they pay attention to and select the information source or sources that are most salient to them. While using a search engine to find information about a particular topic on the Web, people choose the items that they think fit their individual question from a results list, and then they open those Websites. At this point, the study of relevance ends. The resulting use of these relevant materials for information utilization has had only limited study.

Credibility is one characteristic of sources that impacts user relevance judgments. The nature of credibility has rarely been studied within Information Science (Burbules, 2001; Liu, 2004), although Schamber cites a few studies that have looked at it as a criterion for relevance judgments (1994). From social psychology and communication studies (Fogg, Sooho, & Danielson, 2002; Metzger, Flanagin, Eyal, Lemus, & McCann, 2003), however, credibility has been shown to be a "multi-dimensional construct whose two main source-related components are trustworthiness and expertise…" (Wathen & Burkell, 2002, p. 136). The emphasis in these types of studies has been on how information sources might be better constructed to enhance credibility. Within Information Science, however, sources are taken as they exist in the environment, and the question then becomes how do users recognize credibility as one component of their judgment of source quality?

Credibility is also recognized by Wilson (1983) as one component of cognitive authority, or the persuasiveness of a particular source for a reader. A cognitive authority also has to be influential. For Wilson, if a source possesses credibility, or a combination of competence and trustworthiness, and the information it contains could influence the reader, then, the source has cognitive authority for that individual. At times sources have generally applicable cognitive authority, as will be seen in the section on science knowledge; however, cognitive authority also operates on the individual level.

When choosing potential information sources to use for resolving an anomalous state of knowledge, cognitive authority and information quality become important issues. In a ground-breaking study Rieh (2000; 2002) found that information quality is evaluated separately from cognitive authority when information seekers judged the relevance of a Web source. In her study, faculty members and graduate students used think-aloud techniques while completing four tasks, one of which was related to their research and the other three were general interest searches. Her participants mentioned the words goodness, accuracy, currency, usefulness, and importance when making a decision to open a Web resource, and Rieh relates these to information quality. She uses cognitive authority as a label to describe judgments of trustworthiness, credibility, reliability, scholarliness, officialness, and authoritativeness. In Rieh's study judgments of cognitive authority were based primarily at the institutional source level rather than on characteristics of the individual producer of the content, such as his/her credentials or reputation. In other words, quality was discerned from the reputation or authority vested in the institution surrounding the site, i.e., the source's sponsorship or domain. For example, content from a federal agency was considered more authoritative no matter what the characteristics of the individual author might have been.

Though at times Rieh (2002) seems to talk about cognitive authority and information quality as two separate concepts, in 2000 she wrote, "Information quality and cognitive authority are not independent concepts; they are related to each other" (p. 179). In the same way, Wilson (1983) is clear that cognitive authority is part of judging the quality of a resource. As he writes , “But for one who wants to find out what is known or what is the state of some question, the chief aspect of quality is credibility….” (p. 171). It has already been noted that credibility is a part of cognitive authority, so it could be extrapolated that cognitive authority judgments are important in determining quality. Only sources that are judged to be of the highest quality will be allowed to influence the user of that source. There is evidence of this connection in Rieh’s (2000, 2002) study in which academic participants were more likely to worry about cognitive authority issues when the information that they were seeking pertained to their own research topic or to matters of health. When quality really mattered, it was cognitive authority that was cited as a reason for choosing a resource to use. As Rieh writes, “If users find that information originates from trustworthy, credible, reliable, and official sources, they are more likely to believe that the information is good, useful, and accurate” (2000, p.179). Other source characteristics that influence information quality decisions will be reviewed in a later section.

2.2.3 Summary

The research summarized above shows that information seekers can and do create representations of what they need and enter those into information systems as searches. Through a variety of mechanisms, the system presents documents that are evaluated by the seekers for relevance, including topical matching, cognitive authority judgments, and decisions about quality. The assumption in this research has been that the seeker will use what he or she finds for fulfilling their anomalous state of knowledge. There are unique aspects to the situation when the topic is science or health and these differences will be considered in the following section.

2.3 Science Knowledge and Information Seeking

2.3.1 Introduction

The topical context of this research requires an understanding of how the non-scientist, or lay public, comes to know about science and health. The present inquiry follows a more cognitive view of science knowledge, one that holds that knowledge structures are built from information sources and that these can be assessed. The following sections will take a brief look at an alternative view of lay science knowledge termed the *public understanding of science* and then will examine the issue of cognitive authority in science information communication. Finally, it will introduce genetically modified food and food safety as the topical contexts of the two studies reported in this dissertation.

2.3.2 Science Literacy or Public Understanding of Science

A long standing research agenda has attempted to define what non-scientists, or the *public*, knows about the scientific domain. Conducted primarily under the auspices of the National Science Foundation, a series of quizzes has been administered in large surveys that ask questions about science to measure the public's knowledge of "basic facts and concepts about science" and their "understanding of how science works" (National Science Board, 2004, p. 7-15). The most recent of these surveys conducted in 2004, found that just 62% of respondents knew that it is the father who determines the sex of a child (National Science Board, 2006). On the more specific topic of genetically modified food, Hallman, Hebden, Aquino, Cuite, and Lang (2004) found that 56% of people answering a survey in the United States either responded incorrectly or were unsure whether a fruit with altered genes would modify their own genes.

The concept of scientific literacy has been termed the “deficit model” by some (Locke, 2002; Wynne, 1995), and has been used to prove the unfortunate state of science knowledge among adults in the United States and other countries (National Science Board, 2006). However, there is a growing body of evidence that supports the contention that understanding science information is not simply a matter of cognition but is also affected by emotive factors such as trust, credibility, and pertinence to the individual (Roth & Barton, 2004; Wynne, 1996). The public understanding of science model places cognition of science facts in the context of the learner and his or her surrounding community. The context of her need to know may affect what she understands about science phenomena. For instance, to return to an earlier example, until one is confronted with the possibility of eating genetically modified food, the science of it can be completely ignored.

Wilson names this problem of ignoring what does not concern individuals as *private ignorance* (1977). He describes the familiar case that not all topics are of equal concern at all times, so that information is only monitored or sought when concern or interest is strong enough. In many instances, it is not necessary for private ignorance to be informed by *public knowledge* that is made up of those ideas that were “public, available to anyone, now and in the future, who can understand and make use of them” (p.3). Public knowledge is exhibited through an extensive system of knowledge generation, recording, and sharing that involves, in simple terms, scholars as producers, publishers as recorders, and librarians as agents of sharing (Wilson, 1977). Unfortunately, the public knowledge created in public and private science labs, or in other words, the products of the science knowledge industry, have become separated from what the generally educated person knows. In fact, there is evidence that scientists themselves have become so specialized that they cannot understand the results obtained outside their narrow topic interests (Ziman, 2000).

One result of such separation and specialization is that understanding science for the public requires that they interact with “second hand knowledge” – they do not engage in scientific work and may never have done anything remotely like science practices; instead, they can only study what others write about it (Wilson, 1983). The study of second hand information is the primary method for gaining knowledge about most subjects. In fact, the nature of knowing about science has been described primarily as rational and conceptual; it is a matter of organized concepts about the world that are gained through explaining how natural phenomena work (Brewer, Chinn, & Samarapungavan, 1998). As such, one can have the concept or lack it, and this state of affairs can be measured. For adults, measurement has been performed primarily through national and international random sample surveys with a series of questions (see for example National Science Board, 2006). When the sampled adults do poorly on the questions, they are labeled scientifically illiterate.

Scientific literacy is still much talked about, but work that shows that individuals hold a multiplicity of scientific models that are called into use only in context has also been touted in the science education domain (Driver, Asoko, Leach, Mortimer, & Scott, 1994). Though the *public understanding of science* research is interesting, the present work is based on the idea that there is legitimacy in studying what people can explicitly recall about a topic and seeing how information sources impact the levels of that knowledge. The studies in this dissertation follows the longstanding cognitive tradition in education that people learn from the information sources that they encounter and can be tested on that knowledge.

2.3.3 Cognitive Authority and Science

Science knowledge has been verified through a series of credibility and quality checks, including peer review, publication, and continued use (Ziman, 1968). Most of the theories derived from experiments that are found to be incorrect or unreliable, are subject to revision by the community of scientists (Ziman, 1978). The scientific community was, and in some ways still is, made up of concentric circles of peer reviewers, publishers, and then libraries that collect the materials to maintain them for use and posterity. One important aspect of this verification process is the authority invested in science as an institution. Wilson (1983) describes the success of this kind of cognitive authority this way, "Like every other group of inquirers, science aims at results on which all competent inquirers will agree; unlike most other groups, it achieves this goal to a surprising degree." (p. 85).

The advance of the Web as an information resource has changed the process by which an individual's theory of nature moves from private knowledge to public. The Web allows anyone with access to the Internet to publish his or her own theories without the checks and balances that were previously in place. Although vanity publishing was also prevalent when printed material was the norm, for the most part, the cost of production and distribution of printed texts prevented the circulation of materials that were not sanctioned by the traditional gatekeepers. The question of how to judge the quality of texts on the Web is therefore particularly salient in this context. The process that individuals engage in to judge the quality of an information source has been studied in many ways; most notably through the study of credibility.

When a scientific issue becomes pertinent to the public, then issues of cognitive authority of information sources become important. What sources are competent and trustworthy, in other words, credible? Whose advice should be acted upon on this particular topic; in other words, who is the cognitive authority on this topic? These questions are especially cogent because of the increasing ubiquity of Web resources and will be explored further in the section on information quality analysis.

2.3.4 Science Information Seeking Behavior

The public understanding of science model shows that conceptions of science are strongly embedded in contextual issues for many adults. Similarly, research in information seeking has found that context and situation are important to how people approach information sources (Cool, 2001; Dervin, 1997). Those who follow this more holistic approach that encompasses a person's emotional state as well as his/her cognitive state look at seeking information in everyday life (Savolainen, 1995) and the ways that people make sense of their knowledge gaps about a topic (Dervin, 1998). Another view of the processes that lead to information seeking is as an anomalous state of knowledge or the recognition that knowledge about something is incomplete and insufficient for the questioner to fulfill his or her goal (Belkin 1980; 2005). An example in science information seeking would be the recognition by someone that her knowledge of basic genetics is inadequate to help her decide if a reproductive technology is feasible and right for her. Therefore, she seeks information from a source, perhaps from the Web, and then makes sense of what she finds there.

Knowledge building is not completed in a one-time exposure to information; message transfer is not always complete. There is, instead, a multi-stage process that is implemented as a seeker moves from little or no information to understanding of the topic and the accomplishment of a task (Kuhlthau, 2004; 2005). There are many possible tasks for the science information seeker, but the end product is often an evaluative judgment weighing the possible risks or benefits of using a particular technology or exploring a particular scientific process. As users find material relevant to their situation, they make sense of it and construct knowledge that fits their own prior knowledge.

The sources sought are also multi-dimensional. According to an information seeking model first proposed by Taylor (1985) and later elaborated by many authors (Wilson, 1977), when a seeker embarks on the process of finding information, he/she probably begins with his/her own stock of knowledge.[1] The next step might be to go to someone who knows about the subject first hand. As Todd and Edwards found in analyzing the statements of teenage girls about their knowledge of heroin, most would prefer to ask the drug users themselves for this information (2004). When such a person is not available to provide information, a searcher turns instead to an authority; one that is credible, or believable and trustworthy. In other words, the seeker will turn to a person or institution that has cognitive authority for the seeker (Wilson, 1983) who may be a doctor, a lawyer, a priest, or a scientist, depending on the topic at hand. Further, according to Wilson (1983), only when these sources are exhausted, does one usually turn to the secondary sources found in books, periodicals, and on the Web.

---

[1] Stock of knowledge is a phrase used in the work of the phenomenologist Schutz (Schutz & Luckmann, 1973) and is used synonymously with prior knowledge in the present work.

2.3.5 Specific Contexts: Genetically Modified Food and Food Safety

The issue of whether genetic modification of agricultural products is a good application of science know-how has been controversial in the US as well as in Europe (Gaskell, Einsiedel, Priest, Ten Eyck, Allum, & Torgersen, 2001). Estimates show that approximately 167 million acres worldwide were planted with genetically engineered crops since this technology was first approved by the US government regulatory agencies (PEW Initiative on Food and Biotechnology, 2004a). In addition, approximately 80% of the processed foods sold in supermarkets are made from genetically engineered crops either through the use of processed oil, such as canola, or from a corn derivative, such as corn syrup (Hallman, Hebden, Aquino, Cuite & Lang, 2003). Nonetheless, consumer acceptance of this new technology as an appropriate method of producing food for human consumption in the United States continues to be an open question. A survey showed that 48% of American consumers are opposed to these products and would not buy them (PEW Initiative on Food and Biotechnology, 2004b). This level of opposition has remained fairly consistent from 2001 through 2004 despite the fact that most consumers lack substantive information about what these products are and how they might be harmful or helpful (Hallman, Adelaja, Schilling, & Lang, 2002; Hallman, Hebden, Aquino, Cuite, & Lang, 2003; Hallman, Hebden, Cuite, & Lang, 2004). In a national survey with over 1,000 respondents, the Food Policy Institute at Rutgers University found that only 48% of those surveyed knew that genetically modified products are already in the supermarkets, but 56% of their sample had heard or read something about the topic (Hallman et al., 2004). This lack of knowledge seems to reflect a lack of available information. A multidisciplinary study by the Food Policy Institute of Rutgers, the State

University of New Jersey examined the information sources that are available for people who are seeking to understand more about this topic. The present work is part of this large study and looks specifically at Websites as an information channel for this topic.

Food safety is in some ways a broader view of the GM food controversy. Unintentional contamination of food sources during production and manufacture, safe food handling, and possible intentional contamination by a malfeasant are all examples of public concerns around this issue. It is worthwhile to understand how people would search for information if a serious threat developed and how they would evaluate and build knowledge from the Web resources that they encountered about these food safety issues. Quality information can provide people with tools that they can use to more efficiently handle crisis situations. A central question in this dissertation is whether the Web delivers quality information to the public.

2.3.6 Summary

Science can be viewed as public knowledge that lies outside of subjective, private knowledge. Many people in the United States do not have a firsthand knowledge of science. Though this may not mean that they are scientifically illiterate as is seen by many (Hand et al., 2003), it may mean, indeed, that they have gaps, anomalies, or other problems in their understanding that could be filled by seeking more, or correcting inaccurate, information. In this anomalous state they look for information that they can trust and that they believe to be credible. There is a multitude of sources readily available on the Web and these are able to be found with the use of search engines. There is a lack of cognitive authority indicators that previously marked public science knowledge. The next section will examine the nature of Web resources as possible information sources and how their quality is assessed.

2.4 Information Quality Analysis

2.4.1 Introduction

The format of the channel that delivers information influences the utilization of that information. The Web is not a book nor a newspaper article. The information is not fixed; each user makes his or her way through a Website in unique ways, following various links, making different connections. The first part of this section will outline some of the unique characteristics of the Web medium and its impact on information selection and knowledge building.

As it became clear that Websites were presenting durable and important content that was accessible to a wide audience, a number of scholars grappled with how to evaluate the quality of content presented on this new medium. Three different research streams can be identified in this area: expert evaluation, library checklists and user evaluation. Each will be examined, in turn, in the second part of this section.

2.4.2 Characterizing the Web and Web Resources

The Web and its underlying infrastructure, the Internet, is a mixed medium. Media scholars have shown that it has characteristics similar to communication media, like the telephone, and this aspect can be seen in the use of e-mail and instant messaging capabilities. It also broadcasts, in ways similar to television and newspapers; in fact television, radio and newspaper outlets have developed strong Websites to compliment their traditional content. Finally, and more importantly to Information Science, the Web is a storage place for information and a way that information can be disseminated to others (Barnes, 2003). The Web, then, is a unique channel to information that must be evaluated with different methods than those used in the assessment of other information sources. It is also a medium in constant transition with many new features being added with the advent of what is known as Web 2.0 (O'Reilly, 2005).[2]

As a ubiquitous tool for many in the public, it is important to view the Web through the lens of everyday life interaction. As indicated in their introduction to a special issue of *Information Processing & Management* Spink and Cole (2001) write that for ELIS the Internet is a hybrid channel that includes both informal elements of interactive communication such as e-mail, chat rooms, and blogs, and formal components such as Websites. The focus of the present study is the formal communication elements that are found using a search engine and feature primarily one-way communication aspects.

Technology issues. Lesk (2005) describes a digital library as "…a collection of information which is both digitized and organized...." There are many problems with handling digitized text, and most lie beyond the scope of this dissertation. Nonetheless, it must be pointed out that although technology can facilitate distribution of a resource, it also presents difficulties to the user. Researchers in Information Science and Education have noted problems with navigation (Dillon, McKnight, & Richardson, 1993), reading (Kim & Kamil, 2003; Wright, 1993), and learning (Shapiro & Niederhauser, 2004) in a computerized, hypermediated environment such as the Web. Rapp, Taylor, and Crane (2003) identified integration, acquisition, representation, comprehension, organization,

---

[2] The existence and nature of Web 2.0 is still being debated. An alternative view can be found in Boutin (2006).

retrieval, engagement, and individual differences as problem areas that have been investigated in hypermedia systems and might need further investigation in the use of digital library collections. In a review of the learning effects found with using linear versus nonlinear texts, some studies have shown that linear text was a better form for many tasks but that nonlinear texts can stimulate *interdomain referencing,* or the linkages between the domain studied and other linked material (Alexander, Kulikowich, & Jetton, 1994). More studies need to be done in this area especially to reveal the differences between the school-age population and other everyday life information seekers.

Search engines. The standard tool for finding Web content is the search engine, which is the set of algorithms used by several companies that index, allow searching through the use of an interface, and then display choices that match the search query in a results list. Statistics from Nielsen/NetRatings, Inc. (2006) show that the most popular search engines are: Google®, with a 48.5% market share, Yahoo!® with 22.5%, and MSN® with 10.7% in February, 2006. Although the algorithms are proprietary, it is known that the Google® algorithm uses links on other Websites as a weighting mechanism for ordering the results lists. Those Websites that are more frequently linked to by other sites are listed higher on the list (Lesk, 2005).

The choice of resources from a search engine retrieval list can be a problem because many users do not understand what the source document might be; they can discern only the topical content. It has been found that most users are unaware of the differences between a Webpage and a Website when looking for answers to specifically posed questions (Bird, McInerney, & Mohr, 2007; Tombros, Ruthven, & Jose, 2005).

2.4.3 Methods of Information Quality Analysis

Many disciplines have looked at the issue of ensuring quality on the Web, and three distinct research streams have emerged. Expert content analysis is primarily concerned with topical content of Websites and how that conforms to norms within that subject area. Quality checklists have been developed that look more broadly at issues of design, style, and presentation. User evaluation studies of Websites generally ask the individual what the determining factors of quality are for her or him, for instance, might it be credibility or cognitive authority. Studies concerned with expert evaluation, quality checklists, and user evaluation studies will be reviewed in this section.

Expert content evaluation. A number of professions realized in the early 1990s that the Web was becoming an increasingly important phenomena and that their members should take on the responsibility of at least reviewing its content. Medicine was probably most prominent among these expert domains, as it was realized that misinformation was not only a problem but could result in real danger for Web users. A number of researchers reviewed Websites on particular topics in medicine such as diabetes, heart disease, and cancer and published articles on accuracy of the content and other characteristics (Cline & Haynes, 2001; Eysenbach, Powell, Kuss, & Sa, 2002). Though these careful reviews were useful for already posted materials, they provided no way to assess newly created Websites, nor did they guarantee that a site's content would continue to be accurate The AMA guidelines for Websites provide some evaluative criteria that can be used to evaluate sites as they are encountered (Hong, 2006; Winker, Flanagin, Chi-Lum, White, Andrews, & Kennett, 2002). In addition, the Health on the Net Foundation (HON) Website gives a set of standards that Webmasters and developers can follow to show that they are committed to quality information provision. The designation of HON code compliance is applied for by a Website designer voluntarily, and it does not “seek to rate the medical accuracy, validity or appropriateness of the information itself” (Health on the Net Foundation, 2006). This limitation on rating accuracy, etc., may render the code less useful; however, results from a study by Fallis (2004) showed that health related sites that used the HON designation did have more accurate information. In other words, the HON code may be a mark of cognitive authority. Fallis did not determine if users were aware of the HON code and used it as a symbol of quality (2004).

Quality checklists. Library science scholars responded to Website proliferation by trying to evaluate the quality of the package in terms of a number of characteristics. Over the years a number of authors, notably Tillman (2003) have compiled lists of factors that should be considered in choosing a Website for inclusion in a library collection (Beck, 1997; Dragulanescu, 2002; Huizingh, 2000; Wehmeyer, 1997; Zhang & von Dran, 2000). Additionally, Web designers were concerned about how to communicate their messages in this new medium, and they produced literature about the usability of a Website (Turns & Wagner, 2001). The focus in the design literature is to make recommendations for including features on the site that will be attractive and useful to the user. In 2000, McInerney compiled a comprehensive review of efforts to evaluate Website effectiveness up to that time and she identified eight major characteristics of Web quality: content, functionality, authority, currency and stability, links, graphics, coverage, and style (2000). At that time, metatags, or labels embedded in the HTML code that makes up a Website, were included as important items in determining quality; however, recently their use has been questioned with search engines no longer using them as evidence of content due to their overuse and abuse by some unscrupulous Web designers (Sullivan, 2002). There is continual improvement in the capabilities of search engines that may require this part of the tool to be reconsidered in the future; however, for the work in this dissertation metatags were not considered.

The Website Quality Evaluation Tool that resulted from McInerney's (2000) work combines elements of the expert content evaluation, Web design, and library science literatures. Examining content, authority, and coverage, the WQET mirrors the work that was done in expert evaluation of Websites with these being possible measures of cognitive authority. The inclusion of functionality, links, graphics, and style has its origins in Web design but also points to a much more important concern first identified in the studies of hypermedia educational systems, namely cognitive load (Chandler & Sweller, 1991; Paas, Renkl, & Sweller, 2004; Sweller, 2004). Cognitive load research has shown that functionality and other design features can impede the ability of a user to engage with the content in a hypermedia system. Though these studies were usually done on self-contained, limited structure systems, their results are pertinent to this discussion because at heart the Web is an extremely large hyperlinked system (Eveland & Dunwoody, 2001b). Functionality, then, is one important characteristic to consider when judging overall quality.

User studies. A single study has looked at cognitive authority and selection of Websites. Rieh (2000, 2002) had Web searchers look for information on a topic related to their own research. The participants were asked to describe the judgment that they made before they actually decided to view the Website (a predictive judgment) and why they chose to continue viewing it (an evaluative judgment). Rieh found that both the predictive judgment and the evaluative judgment were based primarily on whether the participants had used the site before and the source of the new information being familiar from reputation or previous knowledge (2002). She concluded that credibility and, ultimately, cognitive authority are awarded on the basis of experience and trust rather than primarily on content.

2.4.4 Summary

People interact with Web information resources differently than printed textual information sources (Eveland & Dunwoody, 2001a; Rapp, Taylor, & Crane, 2003). In some studies these differences have been shown to impact knowledge change in various groups of study participants, especially students. These effects may be diminishing over time for younger students and others who have used nonlinear text as a part of their learning environment. It is unknown what effects may occur for the adult lay public.

The many characteristics of information quality described above are useful in formal assessments of Web resources. How many of these are brought into play by everyday users during an active search process remains an open question. In addition, it is worth asking whether these quality characteristics have an impact on knowledge building when using Websites. The topic of knowledge change assessment will be presented in the next section of this review.

2.5 Information Utilization and Knowledge Change Assessment

2.5.1 Introduction

If an everyday life information seeker chooses to search Web resources to satisfy his or her question, chooses and evaluates a particular Website as having high quality information, he or she is then faced with what to do with the found information. Some information is actually utilized in building knowledge about the topic of interest. Information utilization has been rarely studied empirically in Information Science, but it has a theoretical base from within the discipline and other related disciplines that will be explored in the following section. The empirical work on this topic has been done in both Information Science and in Educational Psychology and will be considered under the heading of knowledge change assessment.

2.5.2 The Fundamental Equation

In 1980, Brookes introduced a theory for use in Information Science that he termed the *fundamental equation*. This pseudo-equation, which had no basis in empirical research, captures the basic view of information that is utilized throughout this dissertation. Its terms are simple. To Brookes, knowledge (K) consists of concepts and their relationships that comprise a structure (S). Information (I) acts upon that structure and changes it in some way; perhaps a new node is added or a new relationship between concepts is forged. In an equation where Δ represents change, Brookes wrote $K[S] + \Delta I = K[S + \Delta S]$. In words, this would read that the existing knowledge structure plus a change in information equals the original knowledge structure plus the change. Brookes made no claims about the mechanism or the nature of the change; he only theorized that exposure to information can effect such a change (Brookes, 1980a). To translate this equation into the language used in Educational Psychology, knowledge structure change happens when information is attended to by a person and incorporated for later use.

Todd (1999) reviewed Brookes' definition and placed it into perspective with cognitive psychology and sociology of knowledge theory. He noted that there had been separate streams of research into conceptual utilization, or change in thinking about a topic, and instrumental utilization, or change in behavior, i.e., taking action on a topic, but he found evidence that conceptual utilization was a precursor to instrumental use. He concluded that *information utilization* was the best term to use to describe the phenomenon under study by these other disciplines. He found little empirical research in the field but conducted his own research (Todd, 1999a; 2006) that will be described below.

2.5.3 Knowledge Change Assessment

Educators have long struggled with how to measure what someone knows and how knowledge changes over time. Many studies have been devised that administered tests with prepared questions, supplied some information, and then followed with another prepared test (Mayer, 2003). Recent work has focused instead on what learners can say for themselves about the topic before and after exposure to information in various formats. The following section will review some studies that have been completed by educational psychology research and some in Information Science that builds on these previous studies.

2.5.4 Declarative Knowledge Change

Pioneering work by Chi and Koeske (1983) tracked the growth in a single child's knowledge of dinosaurs. The researchers showed changes not only in the amount of knowledge but the structure of the knowledge retained. As the child's knowledge of dinosaurs increased, his knowledge map became more organized with hierarchical arrangements of concepts displayed. In a similar way, Vosniadou and Brewer (1992) showed that young children had alternative mental models of the earth that included a wide variety of arrangements from flat to round. It was found in these studies that the students had to be given instructional interventions based on the students' own initial conceptualizations in order to effect the desired conceptual change.

The variety of conceptual change outcomes was classified in a landmark review of studies by Chinn and Brewer (1993). They found that seven different kinds of knowledge change could be discerned in studies that used anomalous data (new data that does not fit the prevailing native theories of the students) as a stimulus to learning science concepts. The seven responses to anomalous data exhibited by students in the studies were: to ignore the new data, reject the new data because deemed irrelevant to themselves, keep the new data in abeyance, exclude the data from the already held theory, reinterpret the new data to fit their own conceptual model, create a slightly changed model from the reinterpreted new data, and finally, accept the data and change the theory. Similar reactions could be said to operate after the exposure to any new knowledge. Certainly, in conceptual change, there is evidence of knowledge structure change as well.

If people's privately held theories of science have an effect on their ability to learn a new concept, then it might be conjectured that the level of prior topic knowledge has a similar effect. Alexander, Kulikowich, and Jetton (1994) reviewed sixty-six studies that examined the relationship between interest in a topic, prior knowledge, and the use of both linear and nonlinear texts. Knowledge in much of this research was measured only after an intervention was complete. When the content of prior knowledge was solicited before interaction with the texts, the solicitation was primarily by multiple-choice questions or by assumptions made on the basis of age or grade level. In general, however, it was found that prior knowledge was the most significant predictor of interest in the topic and recall of text elements after use.

Information Science has rarely looked at knowledge change as a function of utilizing information sources. A careful, qualitative study of knowledge change for four school children interacting with prepared texts about heroin was done by Todd (1999b). Prior knowledge was mapped and statements made after each information exposure were analyzed. Knowledge structures that Todd classified as used to “get a complete picture” were more inclusive, elaborative, and integrative (1999b). Other uses for information were described as “get a changed picture”, “get a clearer picture”, “get a verified picture”, and “get a position in a picture.” The study shows that knowledge changes can be described cognitively and recorded for analysis.

The knowledge change studies reported above used prepared texts as the experimental treatment with children or students as the participants. Todd (2006) did not use such texts. Instead, 574 school children engaged in a free search for information about an assigned, curriculum-based topic. Knowledge statements made at the beginning, middle, and end of the curriculum unit were examined according to a coding framework that counted the number of explicated statements at each stage, the structure of those statements, and the extent of topic knowledge exhibited. In general, by the third task, student statements exhibited more structure and coherence than those done in the first task, while the number of statements actually decreased. As students’ knowledge was more synthesized fewer lists of facts were given and more analytical statements were produced.

Very few studies have looked at adults and knowledge structure building in an environment where they choose their own texts of interest. One exception is a study that examined college students and their knowledge and attitudes toward drugs before and after Web searching. Brewer (2003) asked college students to search for information about several kinds of drugs. Prior knowledge and post-searching knowledge were measured by a series of multiple choice questions. The results showed that those with little prior knowledge or experience were affected most by the information that they found on the Web. Their knowledge increased and their attitudes were more favorable towards club drugs than those who exhibited greater knowledge prior to the searching session.

2.5.5 Summary

The studies reviewed above indicate that knowledge structure change can be assessed using statements made by the research participants. In addition, prior knowledge was shown to be an important determinant of the effect that new information may have on knowledge change. Even when the information sources are not controlled a change in knowledge can be detected for both children (Todd, 2006) and adult students (Brewer, 2003). This research informed the design for the studies in this dissertation. The methods will be described in the next chapter.

CHAPTER 3: METHOD

3.1 Introduction

Two studies of information utilization were conducted between July, 2004 and December, 2006. Both studies were portions of larger studies performed under the auspices of the Rutgers University School of Communication, Information, and Library Studies (SCILS) and the Food Policy Institute under grants from the United States Department of Agriculture. They were both designed to understand how everyday life information seekers use Websites to add to their existing knowledge of a topic, but they differed in the subjects that were chosen as context for the research questions. Study 1 focused on the topic of genetically modified (GM) food while Study 2 had three food safety issues, food recalls, foodborne illness and agroterrorism as its context. This chapter will first examine the choice and justification for the study methods. Then, details of the participants, the procedures, and the instruments will be described for each study. Another section of this chapter will contain an overview of the data analysis techniques. Finally, the method limitations will be discussed.

3.2 Method Overview

In order to understand how information seekers utilize sources, a protocol must be designed that examines written statements before and after engagement with a particular source. Therefore, a longitudinal, pre-test post-test, or repeated measures research design was chosen that called for participants to complete instruments from the protocol at two week intervals (Krathwohl, 1998). The participant group served as its own control. There was no random selection of participants, since all were volunteers. The before-and-after assessment increases the external validity of the experimental design but its use is rare in some disciplines (Shadish, Cook, & Campbell, 2002). The difficulties inherent in follow-up with the same group contribute to its infrequency of use. Certainly, problems with participant attrition were encountered during these studies as will be documented in Chapters 4 and 5, but they were solved to some extent by the use of a Web-based follow-up instrument.

According to Julien and Duggan (2000) repeated measures protocols have been used rarely in the Information Science discipline; only a small number of articles on information needs and uses (4.2 % of those reviewed) were identified as using this method between 1984 and 1998. A similar lack was described in the field of medical informatics which is concerned with usability of information systems, despite the fact that many methods books recommend longitudinal design for validity and reliability (Harris, McGregor, Perencevich, Furuno, Zhu, Peterson, et al., 2005). Although usability is an issue outside the scope of this dissertation, the aims of the studies reviewed by Harris, et al. (2005) are similar, therefore further justifying the choice of method for the present studies.

In a repeated measures design the intervening variable is called the *treatment*, with characteristics that are usually controlled by the researcher. In contrast, in these studies the overall protocols were designed by the researcher, while the treatments in these were chosen by the participants themselves. Participants searched for information sources from the Web to answer particular questions posed in the protocols and then chose those sources that they determined to be both relevant to the topics and of reasonable quality. The sources were rated on quality characteristics such as content, authority, and graphics. These quality scores were used as an indication of the relative worth that the participants assigned to these sources.

The participant choice of treatments may balance the researcher imposed and controlled topics that were given to the participants. It has been found by some researchers that prepared search topics limit the effect of individual factors, such as motivation, for seeking information (Watters & Duffy, 2005). Imposition of topics is used in computer system evaluation, however, and Tague-Sutcliffe (1992) contends that there is value in controlling the topics of searches so that comparisons of user choices and results may be made (see also literature concerning the TREC series of conferences on information retrieval system evaluation, especially Dumais and Belkin (2005)). It must also be realized that it would be difficult to anticipate a person's need for consumer information, as in Study 1 on genetically modified food, or for emergency information, as in Study 2 on food safety information. Further compensation for the lack of choice in topics is the naturalistic setting of the equipment and complete control over the search engines and search terms that was given to the participants. It is hoped that this balance increased the generalizability of the results.

Real world applicability is also improved by reaching out to people outside the confines of the University community. In Study 1, an attempt was made to recruit community members to come to the University to participate in the experiment. This strategy was only moderately successful, so a different tactic was employed in Study 2. In this latter study, locations outside the academy were identified and key people asked to participate. These people, in turn, recruited the actual participants. This strategy resulted in a markedly different sample. This will be discussed more completely in Section 3.4.

3.3 Study 1: Information Utilization within a GM Food Context (GMFC)

3.3.1 Introduction

The first study examined information utilization within the context of the topic of genetically modified (GM) food. It will be referred to throughout the rest of this document as the GMFC study. This research was part of a project funded through the Rutgers Food Policy Institute by the U.S. Department of Agriculture (USDA), under the Initiative for the Future of Agricultural Food Systems (IFAFS) grant #2002-52100-11203 'Evaluating Consumer Acceptance of Food Biotechnology in the United States,' Dr. William K. Hallman, Principal Investigator. Table 3.1 provides an overview of the study and its relationship to the Research Questions posed in Chapter 1. Details of the participants, procedures, instruments, and tasks involved in the GMFC are detailed in the next sections.

Table 3.1

Overview of the Genetically Modified Food Context (GMFC) Study Relating Research Questions to Participants, Instruments, and Analysis

Research Question	**Participants**	**Data from Instrument**	**Analysis**
RQ1. How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about genetically modified food?	Students and community members	Appendix D: Q7. Appendix G: Q4.	Analyze answers to C:Q7 and compare to E:Q4. Look for changes in knowledge, description, structure, and extent of topic knowledge using the Coding Framework in Appendix N.
RQ2. In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?	Students and community members.	Variable: Age Appendix D: Q2	Use test of differences to see whether age groups differ in knowledge change.
		Variable: Rutgers Affiliation Appendix D: Q6	Use test of differences to see whether Rutgers affiliated participants differ in knowledge change.
		Variable: Education Level Appendix D: Q5	Use test of differences to see whether participants with differing education levels also differ in knowledge change.
RQ3. How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all?	Students and community members	Appendix F: Median of ratings for 3 Websites.	Test the relationship between the ratings given for authority to the Website(s) and the change in knowledge structure.

3.3.2 Participants

Forty members of the University and the surrounding community responded to advertisements to participate in an agriculture and food study that involved Web searching (See Appendix B). All participants were recruited in accordance with established Institutional Review Board procedures. They were compensated with twenty-five dollars for their time. Twenty of the participants were university affiliates and twenty were not. Eleven participants did not complete the follow-up survey and were subsequently not included in the analysis, leaving 29 participants in the knowledge structure analysis. (See Table 3.2 for selected demographics about the participants.).

Table 3.2

Selected demographics for the Participants in GMFC

AGE	**18-30**	**31-40**	**41-50**	**51-65**
	20	5	3	1
GENDER	**Female**	**Male**		
	17	12		
RU STUDENT	**Yes**	**No**		
	16	13		

3.3.3 Procedures

The procedures used in the GMFC are described in this section, including equipment, locations, tasks, and instruments.

Equipment. Search sessions were conducted on wireless laptop computer equipment in a room at the University. The browser was Internet Explorer and the initial screen was set on Google as a search engine. Participants could change the search engine if they chose. The Follow-up was done by the participants at home or other location via a Web-based survey. Nothing is known about the equipment used for that task.

Tasks. The participants completed consent forms and the Pre-search Knowledge Survey. They were then asked to search about the topic using several of the questions from the survey as prompts (see Appendix E) and to choose three Websites that were helpful to them. These three sources were then rated using the Modified Web Site Quality Evaluation Tool (see Appendix F). The search sessions ended after these evaluations were done. Two weeks later, the participants were contacted by e-mail and invited to complete the Web-based Follow-up Questionnaire.

Instruments. A series of instruments was created to investigate how consumers and students build knowledge about genetically modified food. Each instrument will be described in this section. The first three are listed in the order of how they were administered during the study searching sessions.

- Pre-search Knowledge Survey. This instrument had questions pertaining to demographic information, recent science classes taken, and an open-ended question, “Describe what you know about genetically modified food.” There were also a series of quiz questions adapted from a national, random-sample telephone survey (Hallman, et al., 2003). The full-text of the instrument is found in Appendix D.
- Web search scenarios. Questions from the Pre-search form were used as prompts to searching (Appendix E).

- Website Evaluation Tool. This form was modified from the Website Quality Evaluation Tool (McInerney, 2000; McInerney & Bird, 2005). It contained a series of questions about the Websites that the participants chose from their searches (their treatments). It also included an open-ended question, “Please comment on how this site helped you learn about GM foods.” (See Appendix F for the full-text.)
- Follow-up Questionnaire. This questionnaire was Web-based. Questions for the GMFC included the use of other resources, memory of a Website found and used in the study, and a description of what the participants now knew.

Several of the questions asked in the instrument were not used in the final analysis. The exact questions used and their relationship to each of the Research Questions are shown in Table 3.1.

3.4 Study 2: Information Utilization within a Food Safety Context (FSC)

3.4.1 Introduction to the Food Safety Context Study

The second study looked at the building of knowledge about topics involving food safety, specifically, food recalls, listeria, and agroterrorism. It was intended to gain an understanding of how the Web might be used by the public during emergency food situations. It used funding administered by Rutgers University SCILS and Food Policy Institute as part of the project, USDA-CSREES-2005-51-110-02-335, Dr. William Hallman, Project Director. Table 3.3 provides an overview of the relationship between the Research Questions posed in Chapter 1 and the procedures used in this study.

The FSC was designed to improve upon the GMFC study of knowledge utilization of Websites by everyday information seekers in three ways. The first was the recruitment of participants not affiliated with the University. The second was changes to several of the instruments, including additional questions on some. The third change was to introduce an immediate post-search check of the knowledge structure before participants left the initial search session. All of these improvements will be documented in the following sections.

Table 3.3

Overview of the Food Safety Context (FSC) Study Relating Research Questions to Participants, Instruments, and Analysis

Research question	**Participants**	**Data from Instrument**	**Analysis**
RQ1. How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about food safety?	Community members only.	Appendix I: Q13 Appendix N: Q2-4	Analyze answers to H: Q13 and compare to Appendix M: Q2-4. Look for changes in knowledge substance, amount, structure, and extent of topic knowledge using the coding framework in Appendix N.
RQ2. In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?	Community members only.	Variable Age: Appendix I: Q1	Use test of differences to see whether age groups differ in knowledge change.
		Variable: Level of education Appendix I: Q3	Use test of differences to see whether participants with differing education levels also differ in knowledge change.
		Variable: Occupation Appendix I: Q5	Use of test of differences to see if participants with different occupations also differ in knowledge change.
RQ3. How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all?	Community members only.	Appendix K: Median of rating for three Websites.	Test the relationship between the ratings given for authority to the Website(s) and the change in knowledge structure.

3.4.2 Participants

Participants were recruited from civic and other organizations in the general community in and around New Brunswick, New Jersey. Participating organizations were encouraged to gather a group of members to participate in the experimental sessions. The researcher contacted key personnel at organizations that had appropriate facilities where the searching sessions could be held. These key people made the initial contact with the potential participants showing them the description of the study found in the consent form in Appendix H. Arrangements were made to meet with groups of people at four locations in five sessions. The locations included a library located in a community forty-five miles from the University, an adult education center located in one of the poorest cities in New Jersey, a senior citizens education center twenty miles from the University, and, when a local group could not provide facilities, the computer lab at SCILS. There were a total of 44 participants who completed some or all of the procedures. They were compensated with twenty-five dollars; some participants chose to donate this to the community organization that recruited its members to participate. Selected demographics about the participants are provided in Table 3.4. The participants were all volunteers, however, so they do not comprise a random sample. The results cannot be considered generalizable to the entire population of food consumers.

Table 3.4

Selected Demographics for the Participants in the FSC

AGE	**18-21**	**22-30**	**41-50**	**Over 50**	
	8	5	4	27	
GENDER	**Female**	**Male**	**No Response**		
	30	11	3		
EDUCATION LEVELS	**High School**	**Some College**	**College Degree**	**Post Graduate**	**No Response**
	12	5	11	4	1

3.4.3 Procedures

The changes in the protocol for the FSC are described in this section. Equipment, tasks, and instruments are detailed here.

Equipment. For the FSC, the experiment was conducted at locations where computer equipment could be used with small groups of searchers; a maximum group of 15 participants was gathered at any one location. Web enabled computers were utilized to identify Web resources available at the time of the search. The exact configuration of each computer was dependent on the host facility's capabilities, although all were equipped with the Internet Explorer Browser and could be set to Google as the initial page seen by the participants. One location used filtering software on their computers. This restriction did limit what sources the participants could fully access as they reported during the search sessions, but the extent of these limits cannot be quantified.

Tasks. After completion of the consent form (Appendix H) the participants were asked to complete the Pre-search Questionnaire. They were then asked to search for information on the three topics of interest to the study using the scenarios about each described on the Web searching scenarios instrument. The Post-search Questionnaire was given to the participants before they left the searching session location. After two weeks participants were invited via e-mail or in-person to complete the Follow-up Questionnaire. The text of the e-mail message is contained in Appendix M. The in-person option was necessary because many of the participants in one group did not have e-mail addresses or computer equipment at home. Arrangements were made to meet with this group two weeks after the first session. Participants accessed the Web survey from the same computer lab that they had used in the first Web searching session

Instruments. There were four instruments used to complete the tasks described above. These are:

- Pre-search Questionnaire. This instrument was lengthened from that used in the GMFC and included questions pertaining to the topic. There were a number of questions that were about procedural knowledge (Appendix I, Questions 6-10, and other issues, so were not used in the analysis). In addition, there was a question about how the participants usually decide that a Web resource is believable, credible, or trustworthy. It also contained an open-ended question, "Describe what you know about food safety issues," question number thirteen. Appendix I shows the full-text of this instrument.
- Website Quality Evaluation Tool. The most recent version of the WQET was used as the basis of this instrument. Questions were added that asked for an overall assessment of the quality of the Website viewed (question number 15) and its trustworthiness in an emergency (question number 16). The full-text of the instrument can be found in Appendix K.

- Web search scenarios. Three scenarios were designed to guide the searchers to find pertinent Websites about the topics of interest. These forms also had sections asking the participants to write out the search terms that they thought might apply to each scenario. Then they were asked what they learned from the Website. (See Appendix J for the full-text). The participants in the FSC were asked to investigate information about three different topics as described below:

  Scenario 1. “There was a recent product recall of pre-packaged salads by a major manufacturer. If you had bought this product, find out how this would affect you and your family.”

  Scenario 2. “Listeria is often a contaminant that is found in pre-packaged meats such as hot dogs. You are afraid that you may have been exposed to this at a recent picnic. What are the symptoms of exposure? What should you do to notify the authorities?”

  Scenario 3. “In late December, 1996 a terrorist revealed that chlordane (a pesticide) had been used to contaminate liquid animal fats produced at a Wisconsin plant. This fat was used to feed dairy cattle and the milk from these farms was sent to cheese, butter, and ice cream manufacturing plants. Some people believe that this kind of thing might be done by other terrorist enemies of the United States. How would you search for information about this kind of threat?”

- Post-search questionnaire. This form was a unique instrument for the FSC. It asked the participants to describe what they now knew about each of the three food safety topics: food recalls, foodborne illness, and agroterrorism. (See Appendix L for the full-text of the questions.)

- Follow-up Questionnaire. This was a Web-based survey. More open-ended questions were included for the FSC. These questions were designed to elicit statements about knowledge built during the earlier search session that was attended by the participants. The complete instrument is available in Appendix N.

The responses gathered during the study were not all used for the analysis to answer the Research Questions given in Chapter 1. In fact, the Post-search questionnaire responses were irreconcilable with the questions of knowledge structures, and were not useful for the analysis. Table 3.3 provides details of the specific questions used in the FSC.

3.5 Data Analysis

3.5.1 Introduction

Both studies used knowledge structures as the dependent variable or outcome measure for the protocol. This section will describe the knowledge structure coding process and provide a few examples of how it was applied in both studies. Then, a description of how accuracy and extent of knowledge were determined will follow. The content and quality of the treatments were determined by the participant's ratings using the Website Quality Evaluation Tool. Section 3.5.3 will provide details of the application of these ratings. Finally, a brief description of the analytical tests that were applied will be provided.

3.5.2 Knowledge Structure Coding

Information utilization can be examined by looking at changes in the structure of relational statements written about particular topics (Todd, 1999b; 2006). The primary focus of the analysis was the declarative statements that the participants wrote about their knowledge of the topic on the various instruments. The written statements were examined to determine what parts of the explicated answers could be counted as relational statements. According to the framework developed by Todd (1999a, 2006), a relational statement contains two or more concepts linked together in some way. In this study, a group of words was counted as a single relational statement when it could be read as a complete clause. For example, the original text of a statement was, “It increases food size. I believe that it can be both potentially [good?] and harmful depending on which sources you listen to” (Participant 9, GMFC, Question 7). These two sentences were parsed into three relational statements,

1) It increases food size.

2) I believe it can be both potentially [good?]

3) And harmful depending on which sources you listen to.

Each relational statement was described by using one of nine type categories: Property, Manner, Set Membership, Reasons, Outcomes, Causality, Implications, Generalizations, and Conclusions. These types, in turn, are grouped into one of three classification groups: Group 1 is Facts, Group 2 is Explanations, and Group 3 is Implications. The classification is summarized in Figure 3.

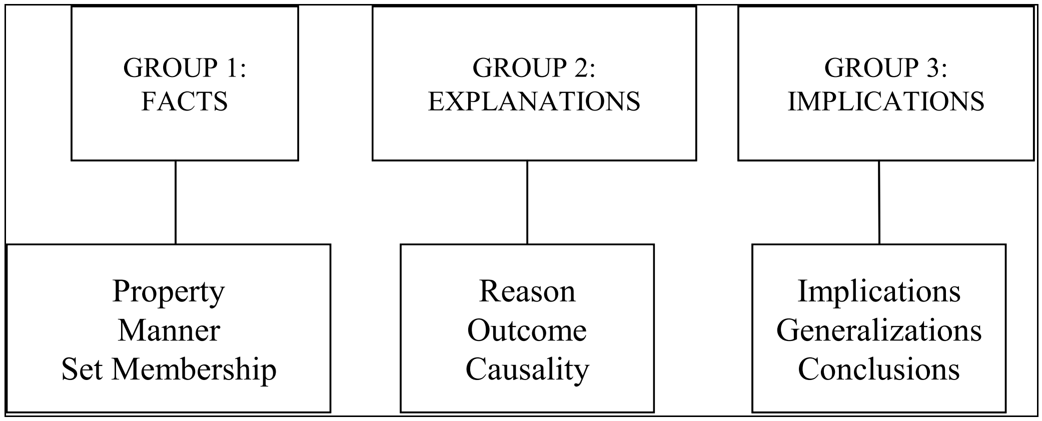


Figure 3. *Summary of knowledge structure codes used in the analysis.*

Group 1 statements are factual. In general, they are about a person, thing, or concept. Within this classification are placed the property, manner and set membership categories. Property type statements relate to characteristics of a concept or person, in the form, “This is that.” The manner category is about how something happens or is accomplished. Set membership involves placing a concept or idea in a class of other ideas.

Group 2 statements are explanatory. Classified into this group are reasons, outcomes, and causality. Reasons link an action with an explanation. Outcomes imply a sequence of events, as in “This leads to that.” Causality is the agent that is responsible for the effect.

Group 3 statements go beyond explanations into the level of implications. They are statements of conclusions, generalizations, and opinions.

In the above example, taken from participant answers to questions posed in the Genetically Modified Food Context (GMFC) study, statement number 1 was classified as a Manner statement in Group 1: Facts. Statements number 2 and number 3 are both Conclusions in Group 3: Implications.

Another example from the Pre-search in the Food Safety Context study will illustrate these same principles. The original statement was:

> “Always keep raw meat separate from vegtables (sic); Shouldn't leave cooked meat out in hot weather since it can produce harmful bacteria; wash fruits & vegetables thoroughly to remove chemicals and pesticides” (Participant 14, FSC, Question 13)

The parsed statements are:

1) Always keep raw meat separate from vegtables (sic);

2) Shouldn't leave cooked meat out in hot weather since it can produce harmful bacteria;

3) wash fruits & vegetables thoroughly to remove chemicals and pesticides

In this example, Statements 1 and 3 are Group 1, Manner statements. Statement 2 is a Group 2: Explanations statement.

The reliability of the knowledge structure coding was checked using a sample of fifty (50%) of the relational statements produced on both the Pre-search and Follow-up instruments during the GMFC. The statements were analyzed by two independent coders and compared. The intercoder reliability was first calculated at 0.41 using a simple percent agreement measure, and at 0.331 using Cohen's kappa. Cohen's kappa is a more reliable measure that corrects for error in percent agreement. After discussion of the differences in the coding of the statements, reliability improved to 0.88 using Cohen's kappa.

3.5.3 Metacognitive Statements, Accuracy, and Extent

There were a number of statements on both the Pre-search and Follow-up that were not relational and therefore could not be classified using the framework. These statements were counted separately and labeled "Metacognitive" because they were about the knowledge of the participants. There were two types of these metacognitive statements. The first type described the participant's lack of knowledge and was assigned when participants answered with "not much" (Participant 20 - GMFC) or "I'm not familiar with it" (Participant 12 - GMFC). This type was labeled *Deficiency*. The second type was used when the participant made a summary of what they knew, rather than describing the content of the ideas themselves, i.e., when a participant wrote, "Exactly how it is made" (Participant 6 - GMFC) instead of "The process of injecting the genetic materials." (Participant 17 - GMFC). The label *Summative* was used for this descriptive metacognitive phrase. The number of metacognitive statements was counted.

The accuracy of all of the relational statements was examined. The researcher has a Bachelor's degree in Biology and had been working with the topics for both studies for several months before the experiments, so was competent to judge whether the statements were accurate. The content was coded for "no accuracy" or "accuracy." There were statements that could not be assessed for accuracy because the content was not factual in any way. These were statement of beliefs, opinions, or fears or metacognitive statements about their knowledge as described previously.

Finally, the overall extent of knowledge that the participants exhibited was assessed by the researcher and two independent coders in the GMFC. Differences in assigned levels were resolved by the researcher. There were three levels, one for little knowledge, two for some, and three for a great amount. Since the statements were short the level was a bit difficult to assess. As with accuracy, the metacognitive statements were not assessed for this characteristic. In the Food Safety Context study, extent of knowledge was determined using the explicated statements themselves.

3.5.4 Determining the Treatments Used

As discussed previously, the treatments in these studies were not assigned by the researcher, rather they were chosen by the participants themselves. During the manipulated search sessions using the open Web, participants made their own choices of Websites that fulfilled the requirements of the task from those listed in the search engine that each used. The ratings that the participants gave these Website treatments using the Website Quality Evaluation Tool (WQET) were used as a description of these sites (see Appendix F and K for the WQET instruments that were used in the two studies). The ratings were used as an independent variable in assessing the relationship between quality of the treatment and the knowledge structures built by the participants, the focus of Research Question 3.

The WQET ratings were on an ordinal scale, from 1 (lowest) to 7 (highest). In accordance to the scale printed at the top of the WQET, a rating of either one or two was combined as Poor, 3-4 (average), 5-6 (good), and 7 (excellent). This allowed for some data reduction.

In the GMFC, the participants chose three Websites to answer questions about a single topic. In order to combine the three ratings into a single description, the median scores for each of the six characteristics measured by the WQET were calculated. The median was used instead of the more standard mean because the ratings were unevenly distributed and the scale was ordinal. This median score was used as an overall treatment description. Medians that were not whole numbers, i.e., 3.5, were rounded to the nearest whole.

The change in the FSC research protocol was designed to allow a one-to-one correspondence between the chosen Website treatment and the topic scenario; therefore ratings for each Website could be related directly to assess their impact on the knowledge structures built for each scenario. Analysis of preliminary data revealed that the open-ended questions of interest for this dissertation were not included in the Post-search questionnaire. As will be shown in Chapter 5, the knowledge structures could not be isolated within the separate scenarios. Therefore, a composite rating of the three Websites viewed was needed, just as in the GMFC. This was done by using the median of the overall rating (see Appendix KQuestion 15) for the three Websites. This summary aided the analysis for Research Question 3.

3.5.5 Describing Changes in Relational Statements

Research Question 1 concerned the change in number of relational statements between those made on the Pre-search questionnaire and the Follow-up. This was calculated for each participant. This difference variable was then ranked according to size of the change with rank of one being the highest. For instance, if a participant wrote two more relational statements on the Follow-up than she or he did on the Pre-search questionnaire, then the difference was +2. This positive difference would place this participant's case at a higher rank than a participant that wrote fewer statements on the Follow-up, and had a difference of -1 or lower. A similar analysis was applied to changes in the median number of statements characterized as group 1, group 2, or group 3 relational statements.

Research Question 2 asked whether there are differences by demographic groupings in the knowledge structures that were described by the coding procedure.

Standard tests of differences, t-tests or ANOVA, were applied to see if the structures varied by age, gender, education level or Rutgers University affiliation in the GMFC. These questions are from the Pre-searching Knowledge Survey, Questions 2, 5, and 6 (see Appendix D). In the FSC similar data is from responses to Questions 1, 2, and 3 on the Food Safety Web User Pre-search Questionnaire (see Appendix I).

Research Question 3 was examined using the results of the Website Evaluation Tool (Appendices F and K) ratings made by the participants. In both studies, it was necessary to calculate the median score for each of the three Websites in order to assess impact on the overall change in knowledge structures. Particular attention was paid to how the knowledge structures of the participants that rated content and authority as being high for their Websites might have been impacted by these treatments. Correlations were run between the individual factor ratings and the total number of relational statements, as well as the number of statements made in each of the three knowledge structure classifications: Facts, Explanations, and Conclusions.

3. 6 Method Limitations

The variability in the search conditions poses some threat to the internal consistency of the quasi-experiment for both studies. Conversely, external validity is increased because the situations are closer to real-life than many experimental situations. The participants controlled the exact treatment by choosing the Websites themselves. The generalizability of the results to a larger population is reduced by the small sample sizes recruited for the two studies; however, the focus on community participants increases the possible applicability to real world situations outside the academy. There is some evidence that the time series design of the study increases the validity by providing a selfcheck to measurement of knowledge structure change. These limitations will be further explored in later chapters.

CHAPTER 4: RESULTS OF THE INFORMATION UTILIZATION IN GENETICALLY MODIFIED FOOD CONTEXT STUDY

4.1 Introduction

As outlined in the previous chapter, the first study of information utilization focused on genetically modified food as a context and was named the GMFC. After a review of the participants, the treatments, or the Websites chosen by the participants in the study, will be described. Then, the explicated statements, both relational and metacognitive, made by the participants will be separated into demographic groupings and their frequency changes described. The accuracy and extent of topic knowledge displayed in the explicated statements will be explored. A section on how the quality ratings relate to the knowledge structures follows. Finally, a discussion of the first study results will complete this chapter.

4.2 Participants

The flyer included in Appendix B was used to invite participants to complete the protocol for the GMFC. Forty people came to the Rutgers University campus and completed the Pre-search questionnaire, the searching sessions, and the modified WQETs (Appendices D through F). Thirty-five participants (87.5%) responded to the call to complete the Web-based Follow-up survey and twenty-nine (72.5%) of those had usable responses to the question, “What do you know about genetically modified food that you didn’t know before participating in the project?” (Appendix F, Question 4).

4.3 The Treatments – Websites Chosen and Rated

The participants were asked to search the Web for answers to three quiz questions that they had been asked on the Pre-Search Knowledge Survey (See Appendix D questions eight through ten). The text of the questions was repeated for them on a separate sheet as shown in Appendix E. They were asked to bookmark all of the sites that they visited and then to choose three of those that they felt were best to evaluate using the modified WQET form found in Appendix F. Finally, the three chosen Websites were rated on seven characteristics: content, functionality, authority, currency and stability, links, graphics, and style. The ratings were from one (poor) to seven (excellent). A single question on the WQET was used as a prompt to illustrate the meaning of the characteristic being rated. For instance, the prompting question for Authority was, "How credible is the information on this site? Consider the sponsor/author."

The items chosen for rating were extremely diverse and were described by the team of researchers on the project to be *Web objects*, rather than Websites. In other words, most had a single page of content about the topic, rather than multiple pages as a content rich Website would have had. There were 87 unique Web objects rated by the twenty-nine participants who completed the Follow-up Questionnaire. Three of these were actually search engine sites, rather than content providers, including Yahoo.com and Google.com. Two others were not able to be identified by the URL or title listed by the participant. Therefore, 82 objects remained in the sample for analysis. Of these, several were rated by more than one participant. Table 4.1 lists the twelve objects that were rated more than once organized by number of times rated, with the URL and the sponsor indicated.

Table 4.1

The Twelve Web Objects Most Often Rated by the Study Participants Showing URL and sponsor.

#Times Rated	URL	Sponsor
8	www.csa.com/hottopics/gmfood/overview.html	Cambridge Abstracts
5	www.bionetonline.org/	Bionet Online
5	www.organicvalley.coop/mediacenter/organics	Organic Valley Farms
3	www.foodpolicyinstitute.org/docs/facts/biotech.pdf	Rutgers University
3	www.fda.gov/	Food and Drug Adm.
2	scope.educ.washington.edu/gmfood	Scope (A consortium of universities)
2	www.actionbioscience.org/biotech/pusztai.html	Actionbioscience
2	www.bbc.co.uk/science/genes/gm_genie	British Broadcasting Co.
2	www.biology-online.org/2/13_genetic_engineering.htm	Biology Online
2	www.biomedcentral.com/news/20031015/04	The Scientist (a journal)
2	www.cqs.com/50harm.htm	Jonathan Campbell
2	www.globalissues.org/Envissues/GEfood.asp	Global Issues

The participants chose Websites that were more often commercial (.com) or organizational (.org) as the best ones that they viewed. The number and percentage of rated Websites in each domain is depicted in Table 4.2. The implications of this finding will be reviewed in the discussion in section 4.6.

Table 4.2

Top Level Domains of the 82 Websites Chosen by the GMFC Participants

Domain	**Number**	**Percentage**
com	31	38
org	31	38
gov	8	10
other	7	8
edu	5	6
Total	82	100

As stated earlier, the participants chose three different Websites as the best for answering the questions that were posed. They rated each of them using the Website Quality Evaluation Tool (see Appendix F). The median of the three quality ratings for each characteristic was calculated and plotted to show the range (see Figure 4.1).[3] Although the original scale was seven points, the WQET categorized scores of 1-2 (poor), 3-4 (average), 5-6 (good), and 7 (excellent). Due to the small numbers of ratings left in the sample, the more condensed four category scale was used in the analysis. Figure 4.1 shows how the scores for all seven characteristics were distributed.

---

[3] All median scores that were not whole numbers were included in the nearest category, for example, a median rating that equaled 5.5 was included with a rating of 6.

The ratings for functionality, links, and style were consistently high, all between good and excellent on the scale. Therefore, these characteristics were not analyzed further. The participant ratings on authority and content also clustered around three with outlier Websites shown by record number and marked by stars in Figure 4.1. Currency and graphics had wider ranges with some ratings being as low as poor. Content, authority, currency and graphics were used as independent variables to see if participants who rated their Websites similarly on any of these characteristics had a similar pattern in the number of relational statements of any classification, accuracy, or extent of knowledge as exhibited on the Follow-up. This was the focus of Research Question 3: How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all? Results of this analysis will be described further in Section 4.5.

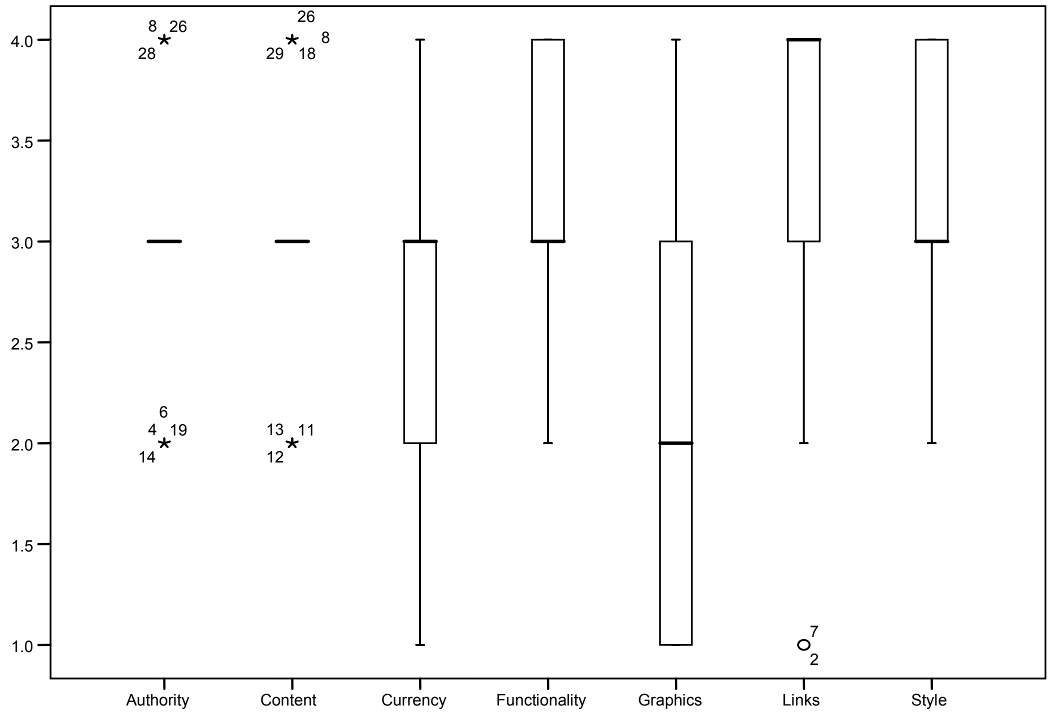


Figure 4.1. Boxplot of median participant Website ratings on all seven characteristics on the WQET.

It is useful to take a closer look at how the WQET ratings were applied to individual Websites. Only twelve of the 82 Websites were rated by more than one person and only five were rated by more than three. The ratings of these five sites had enough variability in the scores to allow them to be compared to each other on the WQET characteristics. The median scores awarded to these Websites by the participants who rated them indicates that Authority scores were consistently high in the good to excellent range, while Currency and Graphics scores had a broader range, from average to good (see Table 4.3).

The WQET ratings for all participants were subjected to statistical tests to see if any of the demographic variables were related to the scores given. There were no statistically significant differences between any of the demographic groupings in how the ratings were applied to the Websites.

Table 4.3

Median WQET Ratings for the Top Five Most Often Rated Websites

	#Times Rated	Domain	Authority	Content	Functionality	Currency	Links	Graphics	Style
Cambridge SA	8	.com	excellent	excellent	excellent	average	excellent	average	excellent
Bionet	5	.org	good	average	good	average	average	good	good
Organic Valley	5	.coop	good	good	excellent	good	good	average	good
Rutgers	3	.org	excellent	excellent	good	good	good	average	good
FDA	3	.gov	excellent	good	excellent	average	good	good	excellent

4.4 Changes in Knowledge Structures

Information utilization is measured by examining the knowledge structure, or internal cohesiveness, found in explicated written statements. The statements produced by the participants were parsed into relational statements, defined as a complete clause with two linked concepts. Each parsed statement was analyzed and placed into one of nine categories according to the descriptions in the knowledge structure coding framework (See Appendix O). The individual categories are collected into three groups: Group 1 statements are Facts, and include statements about the properties of a concept, the manner in which it is performed, and whether it is a member of a set of items; Group 2 statements are Explanations, including reasons, outcomes and causality; and Group 3 statements are Implications, or statements of opinion, conclusions, and generalizations. In addition, some explicated statements were metacognitive, or descriptions of knowledge. Metacognitive statements can be deficiency statements, as in “Not much” or summative, as in “Only what I hear on the news.”

Changes in the types of statements explicated in the responses were seen between the Pre-search and the Follow-up stages, as can be seen in Table 4.4. The total number of relational statements was slightly higher in the second assessment. The majority of statements were in the Facts group at both times. The number of explanations decreased while the number of implications increased. Metacognitive statements decreased only slightly.

Table 4.4

Number of Explicated Statements (Relational and Metacognitive)

	Pre-Search	Follow-up
Total Explicated Statements	**58**	**58**
Relational Statements	**47**	**48**
Facts Group Total	*24*	*28*
Property	14	12
Manner	9	10
Set Membership	1	6
Explanations Group Total	*17*	*12*
Reason	4	6
Outcome	7	2
Causality	6	4
Implications Group Total	*6*	*8*
Implications	2	1
Generalizations	0	0
Conclusions	4	7
Metacognitive Statements	**11**	**10**
Deficiency	9	1
Summative	2	9

It can be seen in Table 4.4 that in the Pre-search most (82%) of the metacognitive statements were deficiency in type. Sometimes these statements were preceded by or followed from complete relational statements. Five of the eleven participants who wrote metacognitive statements in the Pre-search said something similar to Participant 16, who first wrote "not much" and then proceeded to explicate "except that I know that I must have eaten something genetically modified" or in one case several relational statements were followed by "I don't know much" (Participant 14). In the Follow-up the metacognitive statements were primarily summative.

4.5 Knowledge Structure Changes for Participant Groups

4.5.1 Introduction

Research question 2 concerns the relationship between demographic variables and change in knowledge structure. Participants were asked to identify their gender, age, educational level, and university affiliation on the Pre-search questionnaire (See Appendix D). This information was used in a series of statistical tests to see if they were related in any way to the knowledge structures found in the statements on the Pre-search and Follow-up. The next sections describe these tests and their results.

4.5.2 Number of Relational Statements

The mean number of explicated relational statements of each type was calculated for gender, age, educational level, and university affiliation. Figure 4.2 shows the mean of the total number of relational statements for females (1.8 statements) on the Pre-search to be slightly higher than for males (1.3 statements) on the same instrument. On the Follow-up this difference essentially disappears. Each type of relational statement, facts, explanations, and implications is shown separately in Figure 4.2. The two groups did write statements that varied in type, but this comparison was not statistically significant.

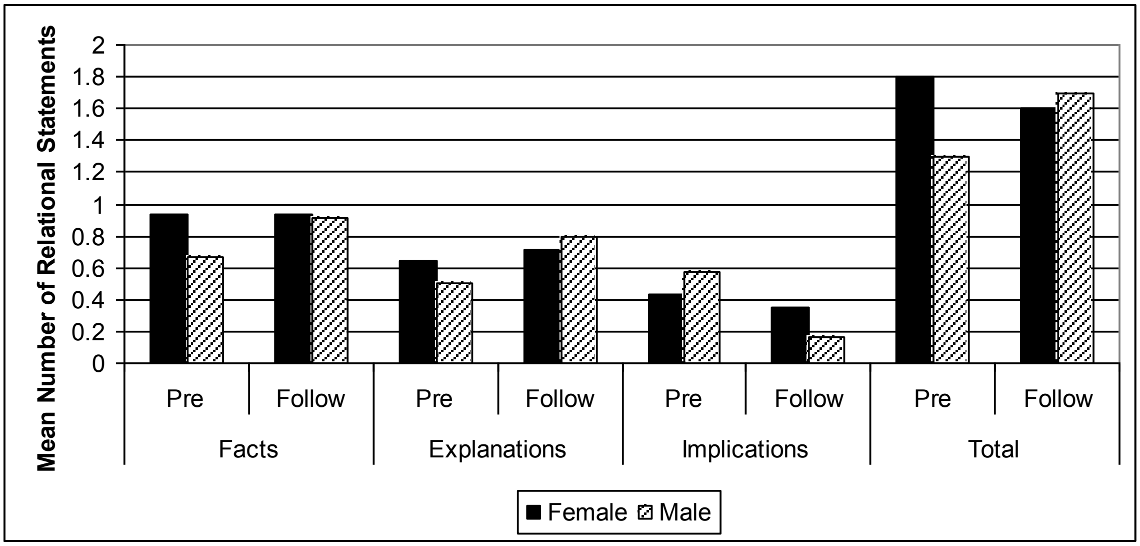


Figure 4.2. The mean number of relational statements explicated by females and males on both the Pre-search and Follow-up instruments.

A similar analysis for age groups was inconclusive because the groups were not balanced in number. The second oldest group, 41-50, had only four participants and the oldest, 51-65, had only one representative in the sample. The groups were combined in an effort to increase the analytical power of the test of means. The means, though not significantly different, are depicted in Figure 4.3.

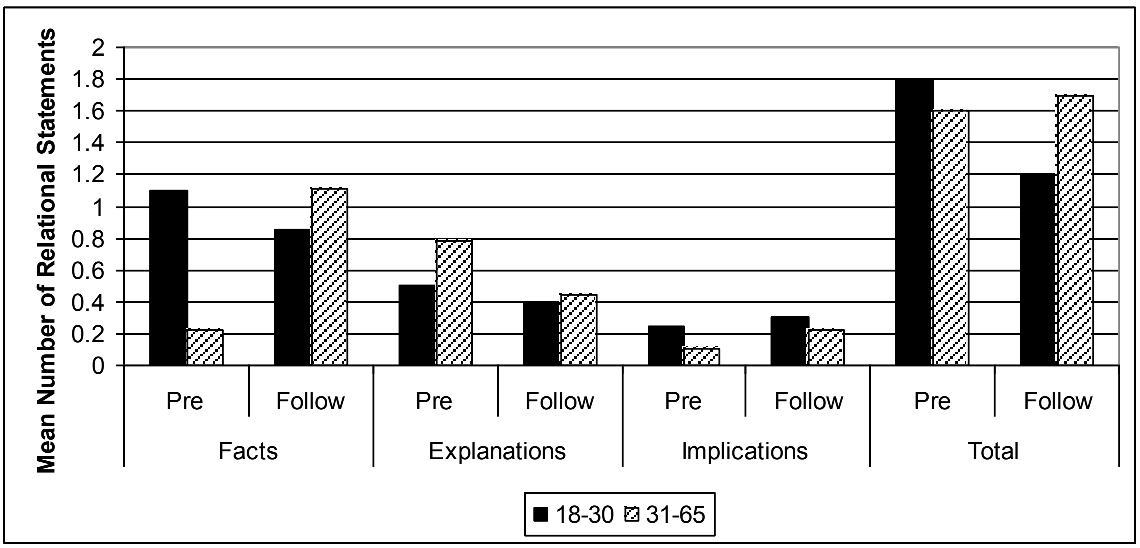


Figure 4.3. Mean number of relational statements made by the participants on the Pre-search and Follow-up separated by age group.

The group of participants who had completed an associate's degree had only two representatives in this participant sample so this category was combined with those who had finished high school. The relationship between educational levels and mean number of relational statements of each type as revealed by one-way ANOVA was interesting. Each of the groups except those with advanced degrees experienced some increase between the Pre-search and the Follow-up in the mean number of statements made (See Figure 4.4). Although the total mean number of relational statements was not significantly different between the groups, the number of Fact statements made by the group of participants who had completed college was significantly higher $F(2, 28)=5.44$, $p<.05$. The participants who had completed master's degrees wrote more Implications statements on both the Pre-search and Follow-up instruments.

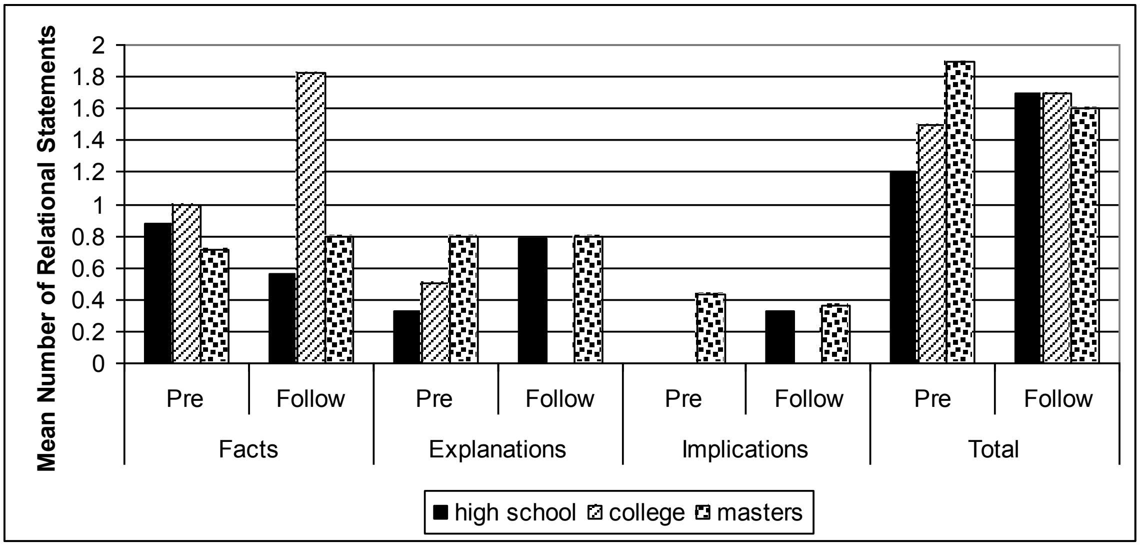


Figure 4.4. Participant education levels and the mean number of relational statements at Pre-search and Follow-up stages.

The demographic question about the most recent science oriented class taken was abandoned. The answers were too variable, in both content of the classes and the length of time from completion, to allow meaningful analysis.

The mean number of relational statements made by university affiliates was significantly different from the number made by non-university affiliated participants at the Pre-search stage of the experiment as indicated by the independent samples t-test $t(29)=0.55$, $p<.05$, $r=.10$. The small effect size, $r=.10$ indicates that there is only a small influence on the number of statements at this stage. At the Follow-up, the mean changes were in a negative direction and the effect size was larger, $t(29)=-.762$, $p<.05$, $r=.35$. Figure 4.5 shows how the mean number of relational statements made by university affiliated participants was lower than the non-university affiliated group on the Pre-search, while the opposite was exhibited at the Follow-up. In addition, the nature of the statements was different for the two groups. The university affiliates wrote more Explanation and Implications statements on both instruments than the non-affiliated group.

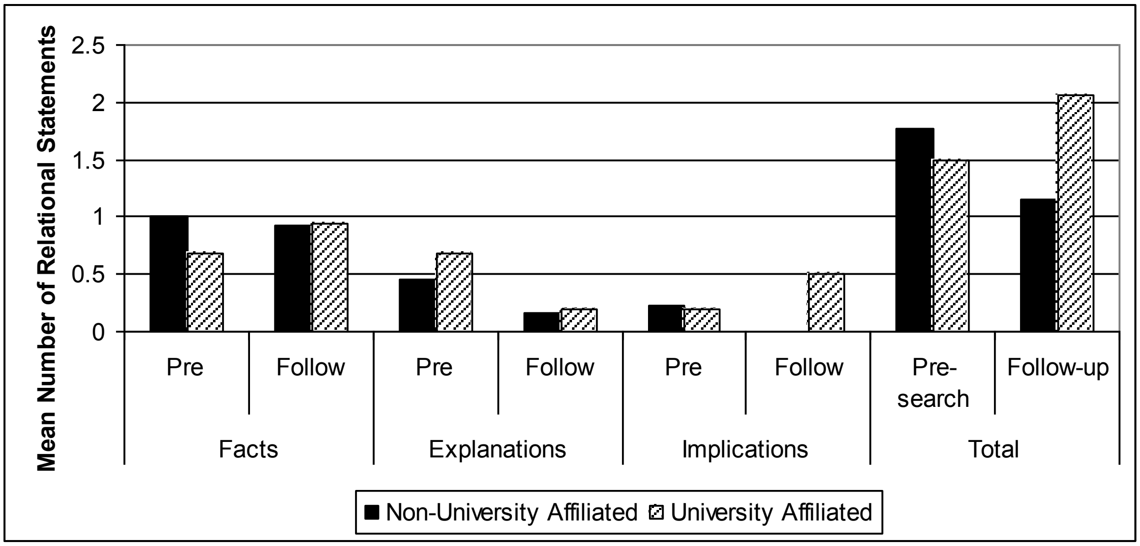


Figure 4.5. University affiliation and the mean number of relational statements made on Pre-search and Follow-up.

Viewing only the mean number of statements for the two groups obscures the wide range in number of responses made by the university affiliated group. The box plot in Figure 4.6 indicates that university affiliates wrote between zero and five statements on the Follow-up, while the non-university affiliates wrote between one and two.

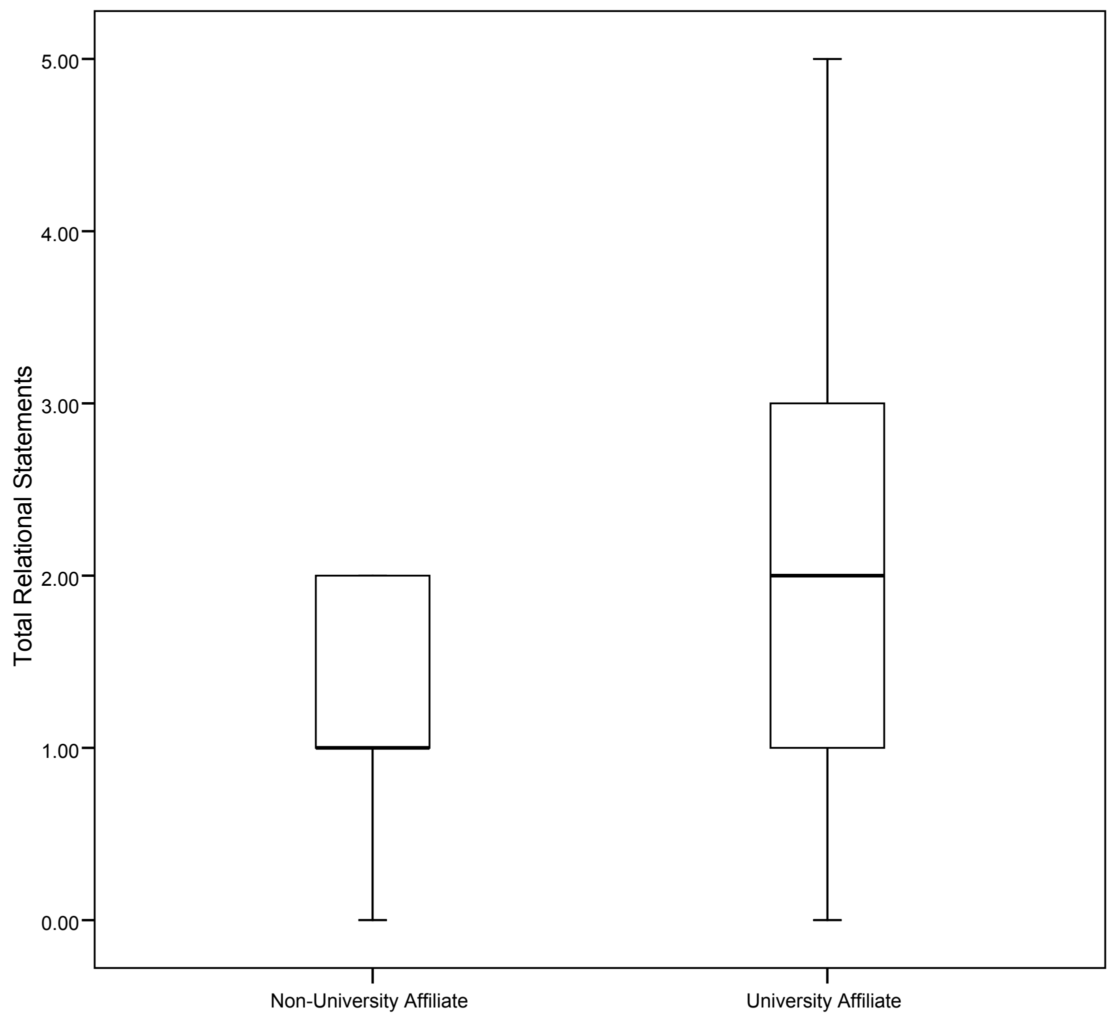


Figure 4.6. Boxplot showing the range in the total number of relational statements made by university and non-university affiliates on the Follow-up instrument.

4.5.3 Change in Metacognitive Statements

The mean number of metacognitive deficiency statements made by all of the participants at the Pre-search and Follow-up stages was compared using a paired-samples t-test. During the Follow-up, participants were less likely to explicate these deficiency statements, $t(29)=.20$, $p<.05$, $d=.42$, a result which indicates statistical significance. Also, at the Follow-up stage participants were more likely to use summative cognitive statements; nine out of ten metacognitive statements made on the Follow-up were of this type (see Table 4.4).

4.5.3 Accuracy of Statements

Accuracy was judged dichotomously; statements were accurate according to accepted knowledge about genetically modified food or they were not. Metacognitive statements and Implications statements were not included in the accuracy ratings. The researcher was the sole coder of this characteristic. The resulting classification of the accuracy of the 58 statements written by the participants at both the Pre-search and Follow-up stages can be viewed in Figure 4.7. The percentage of statements that could not be rated increased from 20% on the Pre-search to 33% on the Post-search. This result reflects the increase in the number of Implications statements that were not analyzed, because this type of statement is often an opinion or belief making accuracy judgments invalid.

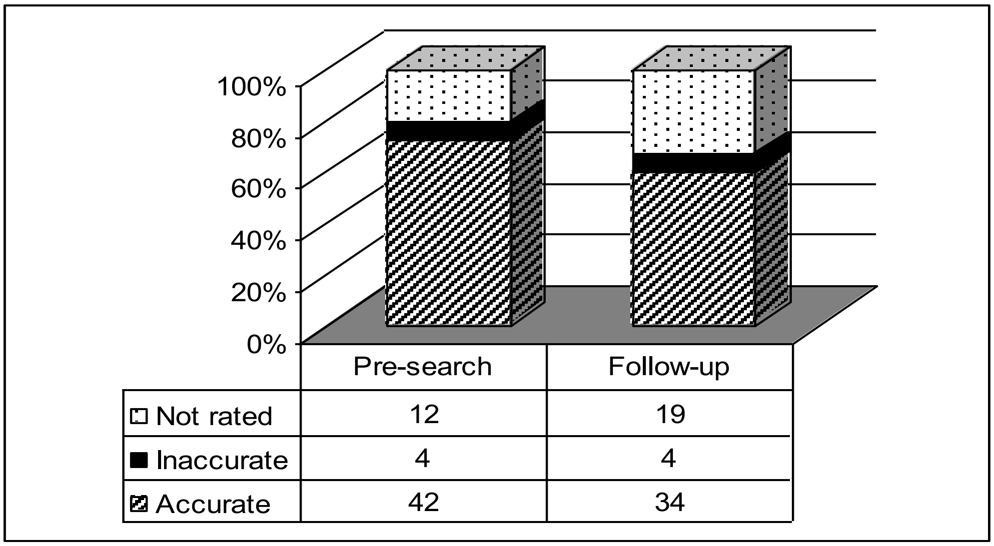


Figure 4.7. Percentage of statements in each accuracy category on the Pre-search and Follow-up.

4.5.5 Extent of Topic Knowledge

The extent of participant knowledge about the topic was determined by reading the statements made on the Pre-search and Follow-up instruments. Three coders who were knowledgeable about the topic rated each of the participants as having little knowledge, some knowledge, or extensive knowledge. Metacognitive statements were not included. Differences in ratings were resolved by the researcher. The results are illustrated in Figure 4.8. An overall increase in knowledge is indicated here, as the number of participants with little knowledge decreased. The number of those that could not be rated because they were beliefs or conclusions increased.

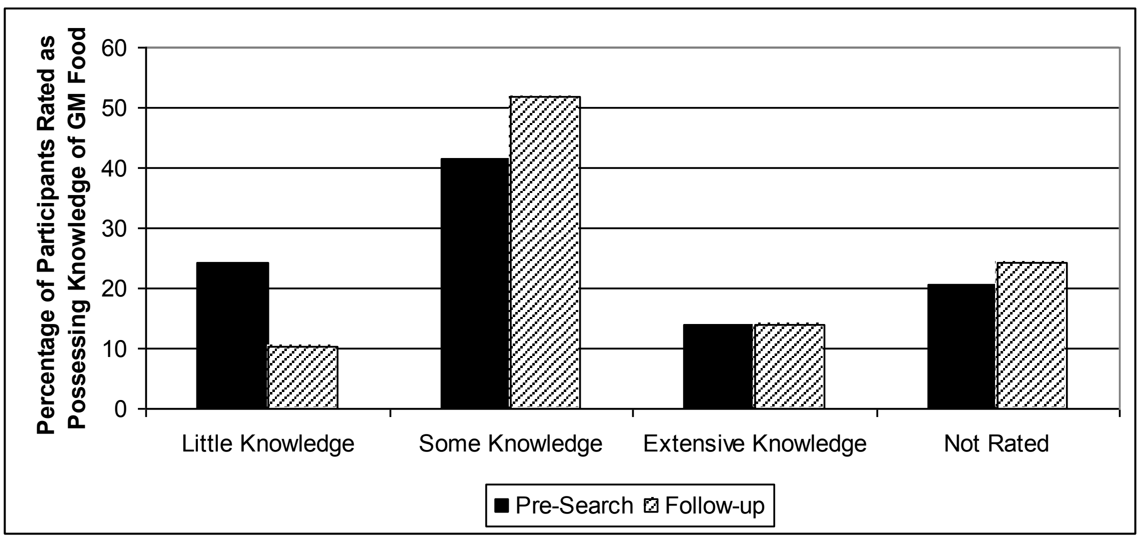


Figure 4.8. Extent of participant topic knowledge on the Pre-search and Follow-up.

4.6 Quality Ratings and Knowledge Structures

The relationship between the change in knowledge structures and the quality of the treatments that the participants chose was examined by reviewing the correlation between the number of relational statements of each participant and the value awarded to some of the quality measures. The boxplot of the WQET ratings in Figure 4.1 indicated that there was very little variation in the scores for content, functionality, links, or style. The ratings for graphics and currency, however, had a wider distribution suggesting that their use in correlation studies may be fruitful. In addition, authority was used, because it was of particular interest in the study.

The scores on these variables were dispersed, but they were not evenly distributed. This situation called for the use of the nonparametric measure of correlation, Spearman's rho (Krathwohl, 1998). Correlations were attempted between the total number of relational statements made on the Follow-up and the scores for the individual variables of currency, graphics, and authority. Only the relationship between the graphics scores and relational statements rose to the level of significance r_s=-.372 ($p<.01$). The boxplot in Figure 4.9 shows that the participants who gave the Websites that they viewed low graphics scores wrote more relational statements on the Follow-up questionnaire than those who gave higher graphic scores.

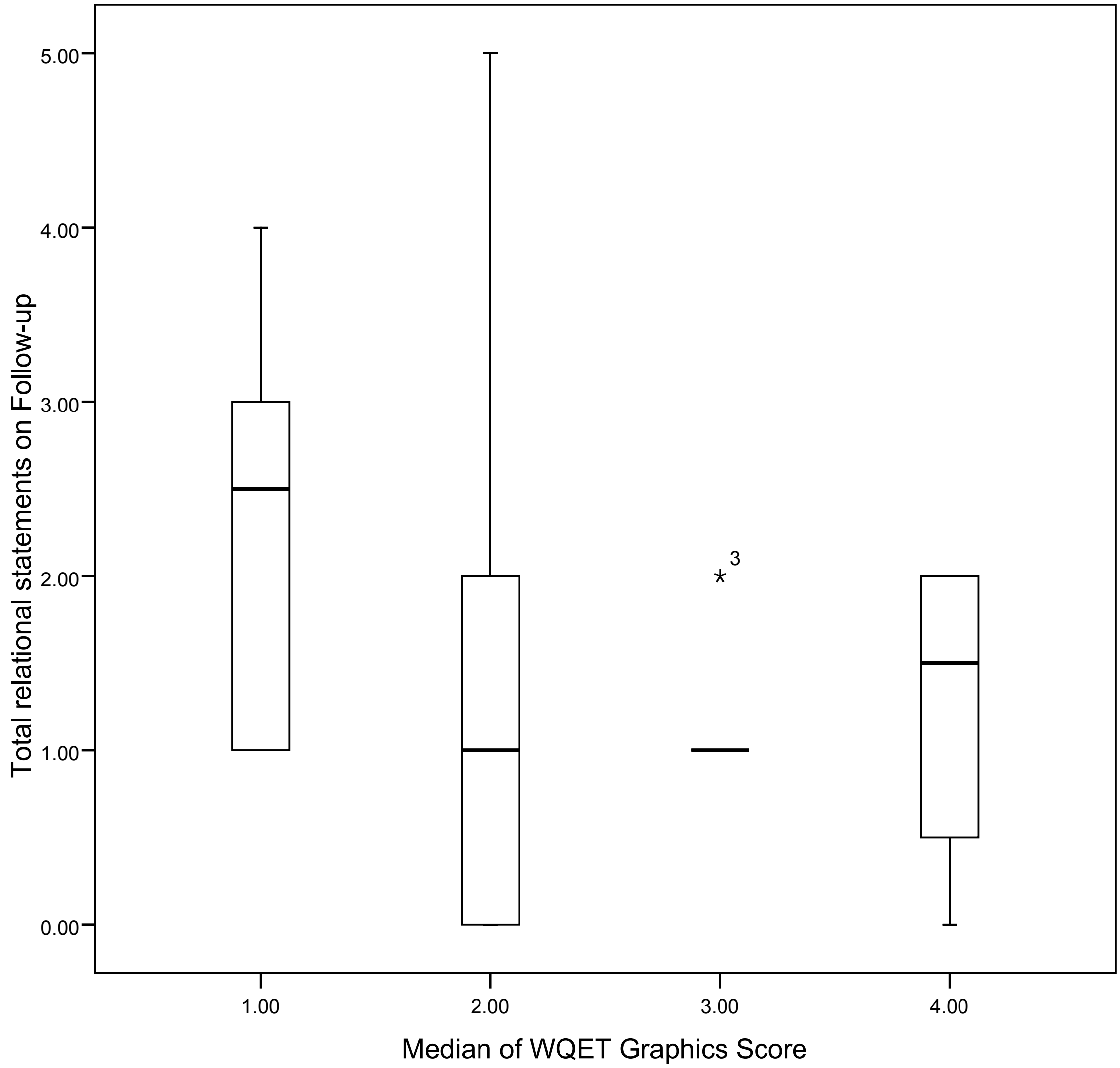


Figure 4.9. Boxplot showing total relational statements separated by median graphics score. (*3 is an outlier participant.)

The significant relationship between graphics and the total number of relational statements led to an inquiry about whether the individual classification of the statements was also significantly related. No such relationship could be demonstrated.

It was also surmised that graphics might account for the rank of the difference between the Pre-search and the Follow-up total number of relational statements made. This relationship could not be detected. Similarly, no relationship between authority scores and the rank of the difference was found. Similar analysis was done for the statements made in the separate classifications: Property, Explanations, and Implications. None of the relationships with graphics and authority were significant.

4.7 Discussion of Findings

The significant difference in the mean number of relational statements made on the Pre-search and the Follow-up between university affiliated participants and those that were non-university affiliated leads to the question advanced by Hargittai and Hinnant (2006) about the adequacy of using university students to theorize about the usability of information systems. Differences did not seem to depend on age or educational level. The fact that age or educational level did not make a difference but university affiliation did may be related to the fact that the university affiliates are involved in formal learning situations where they are more often required to explicate their specific knowledge. In any case, this finding inspired research using this method with people more genuinely embedded in the surrounding communities. That research is the subject of the next chapter.

There were fewer metacognitive deficiency statements in the Follow-up than in the Pre-search. This type of statement seemed to be replaced in many cases by meta-cognitive summative statements. For instance, Participant 12 made the statement “I’m not familiar with it” on the Pre-search. This contrasts with the three statements he or she made on the Follow-up: 1)“What they are”; 2)“how they are made”; and 3) “the advantages and disadvantages of them”. There is no way to know whether this participant could have recited processes that would have illustrated what he or she knew about “how they are made.” If surveyed or quizzed this person may have been able to say that the plant nuclei are injected with the foreign DNA, but this cannot be known from this data.

The finding that metacognitive statements are used rather than relational statements does lend credence to the public understanding of science stance that quizzes do not adequately capture the state of scientific literacy in this country or elsewhere (Roth & Barton, 2004; Wynne, 1996). It is very possible that people like Participant 12 have vague notions of what they know about these topics and can say they know “how they are made” without being able to explain the exact methods. This lack of certainty about the extent of knowledge was also displayed in the five cases where the first statement was a metacognitive deficiency statement and then was followed by several accurate statements, or vice versa. The initial response to a survey item might be “I don’t know” about the topic even when a reasonable amount of knowledge was present. With no opportunity to elaborate, the five participants who actually could elaborate when given the chance would be labeled scientifically illiterate by the quizzing process.

The participants in this study did not seem to use the Website domain as an indicator of quality. Previous survey research had indicated that when asked to think in the abstract about Websites, respondents would cite .gov and .edu as domains that would be more trusted and credible (Liu, 2004; Treise, Walsh-Childers, Weigold, & Friedman, 2003). When actually engaged in a search for information as in this study, however, participants more often chose .com (38%) or .org (38%) domains to rate with the WQET. It must be remembered that the choice of a Website for rating involved a decision that it was one of the best three viewed during the search session. Therefore, the fact that only 23% of the rated Websites were either .gov or .edu shows that domain name was not a primary consideration for participants when assigning quality. This point is further supported by the high median ratings given to the Authority characteristic. Participants were asked to consider credibility when assigning a value to the Authority score. Reviewing the results for the top five most rated Websites listed in Table 4.2 shows that both .com and .gov were considered excellent in terms of Authority and by extension, credibility. This result may be an example of the importance of satisficing in information seeking (Agosto, 2002; Prabha, Silipigni Connaway, Olszewski, & Jenkins, 2007) .[4] The participants may have simply chosen material that answered the questions that they were asked. Other considerations may have been secondary.

The negative relationship between graphics scores and total number of relational statements made on the Follow-up is interesting. This result may indicate a difference in learning styles of the participants. Those who note the poor quality of graphics may be less able to express themselves in written statements and would benefit from being able

---

[4] The term *satisficing* was coined by Herbert Simon (1956). The citations noted here are to applications in Information Science.

to draw a picture of what they know (Vosniadou & Brewer, 1992). An alternative explanation may be that the respondents had a varied view of what the WQET referred to as graphics. The Website evaluations listed in Table 4.3 shows that both Cambridge Scientific Abstracts and the US Food and Drug Administration Websites were given good scores on graphics. A check of these by the researcher revealed that neither of these sites had pictures, graphs, or charts. The addition of an n/a choice may have helped in this case, as it stands, it is unknown what the participants thought they were rating when these scores were awarded.

The results of the GMFC raised several issues that informed the design of the second study with a food safety context, the FSC. The FSC focused exclusively on non-university affiliates. The Pre-search questionnaire was expanded in order to include occupation and food training as further demographic descriptions. In addition, the WQET was re-written to better capture the thinking of the participants about the meaning of some of the Website characteristics. These changes will be further discussed in the next chapter.

CHAPTER 5: RESULTS OF THE INFORMATION UTILIZATION IN FOOD SAFETY CONTEXT STUDY

5.1 Introduction

The second study of information utilization as measured by knowledge structure building focused on the context of three food safety issues: food recalls, foodborne illness, and agroterrorism (the intentional contamination of food with the intent to harm). It will be termed the Food Safety Context (FSC) study throughout this chapter. The participants in the study will be described first. A section on the Websites, or, in other words, the treatments, that they chose will follow. In the later sections, the knowledge structure changes are analyzed. The final section will present a discussion of the findings.

5.2 Participants

The FSC was designed to reach only participants who were not affiliated with the University. To that end, public institutions that had appropriate computer facilities were contacted and asked if they and their constituents would like to participate in the project. In turn, the initial contact with the participants was through key personnel in these organizations. One organization that did not have appropriate facilities agreed to meet at the School of Communication, Information, and Library Studies (SCILS) to use the computer lab there. The strategy proved successful, all of the 44 initial participants were not affiliated with the university. Some, however, were students in other educational institutions, like the adult education center, and identified themselves as such.

Five experimental sessions in four locations were arranged. The locations included a public library, an adult education center, a senior citizens educational facility, and a computer lab at SCILS. The protocol for the FSC required almost two hours of work from the participants, and some of the instruments proved difficult for some of the participants to complete due to lack of search experience. In addition, the Web-based Follow-up was done voluntarily two-weeks after the initial searching and required both an e-mail address and the use of a computer. Because the participants in one group did not have e-mail addresses or easy computer access, a return visit to that facility was arranged. A number of the Pre-search respondents in that group were unavailable that day, therefore, seventeen of the original participants, or 39%, completed the Follow-up.

The percentage of participants who fit each demographic category was consistent throughout the three stages of the experiment, as illustrated in Figures 5.1 through 5.5, however, there were some slight differences. In the Follow-up, the 41-50 year old age group was no longer represented and neither were educators as an occupation. In contrast to the first study, the Genetically Modified Food Context (GMFC), the educational level was quite evenly distributed in the FSC. The percentage of those completing high school as their highest degree (27%) was nearly equal to that of those completing college (25%), and those completing post-graduate work (25%). The percentage of people with only a high school degree in the Follow-up was 17%.

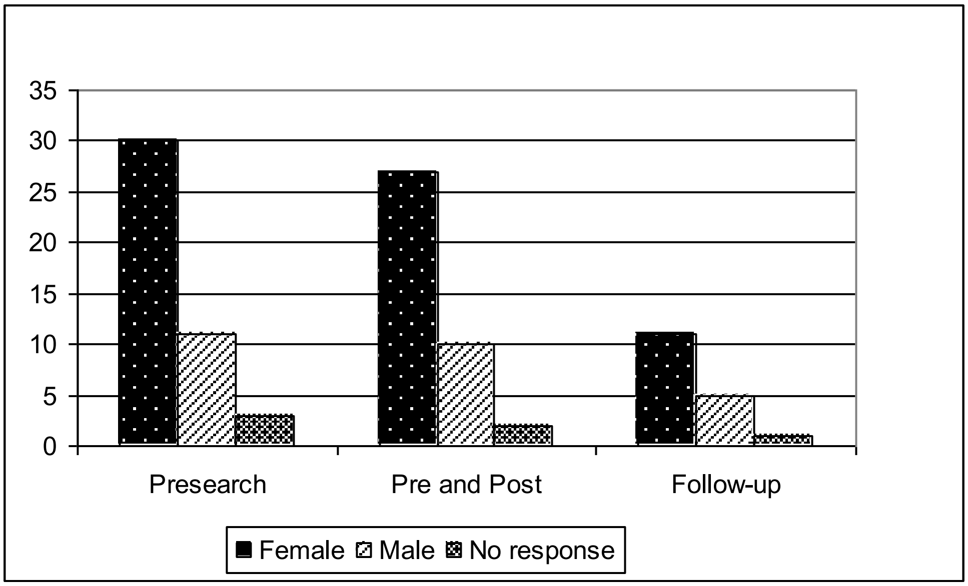
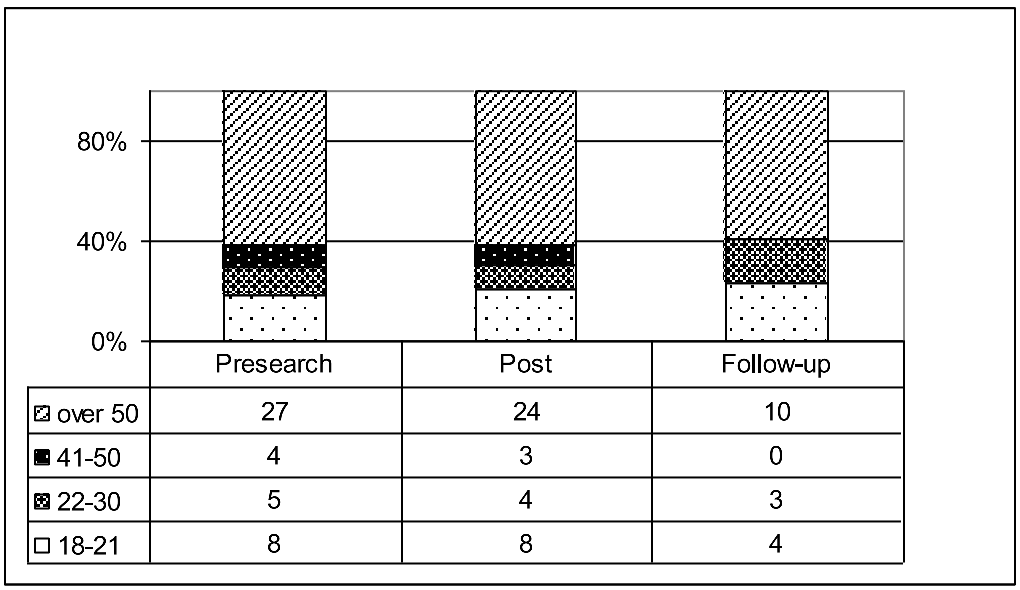


Figure 5.1. Number of participants in each gender group at each stage.



	Presearch	Post	Follow-up
over 50	27	24	10
41-50	4	3	0
22-30	5	4	3
18-21	8	8	4

Figure 5.2. Percentage of participants in each age group at each stage.

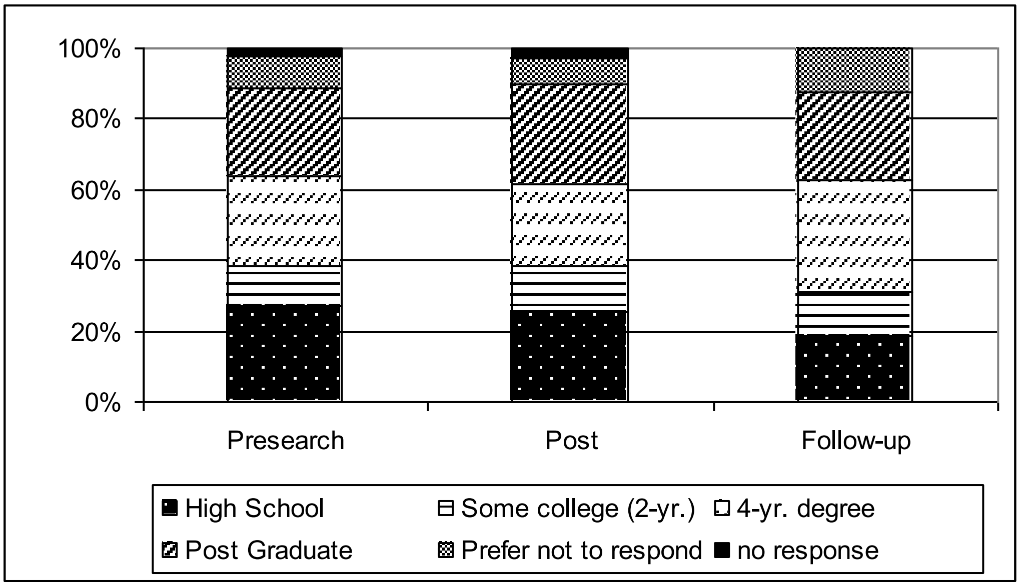


Figure 5.3. Percentage of participants who disclosed their educational level and their completion of each stage of the protocol.

The definition of "Occupation" was interesting for this sample. When asked about their occupation, many of the respondents checked "g. Other" and then elaborated by writing "retired" and their former occupation (see Appendix I). When this former occupation was one of the given choices on the survey that response was included in that choice for research purposes. For instance, one of the respondents wrote in the "Other" space, "retired from the business world" – therefore, this response was added to those who had chosen "e. business". When there was no description of the former occupation, or if it did not match one of the included categories, the response remained in the "Other" category. This change reduced the total in "Other" from sixteen to twelve.

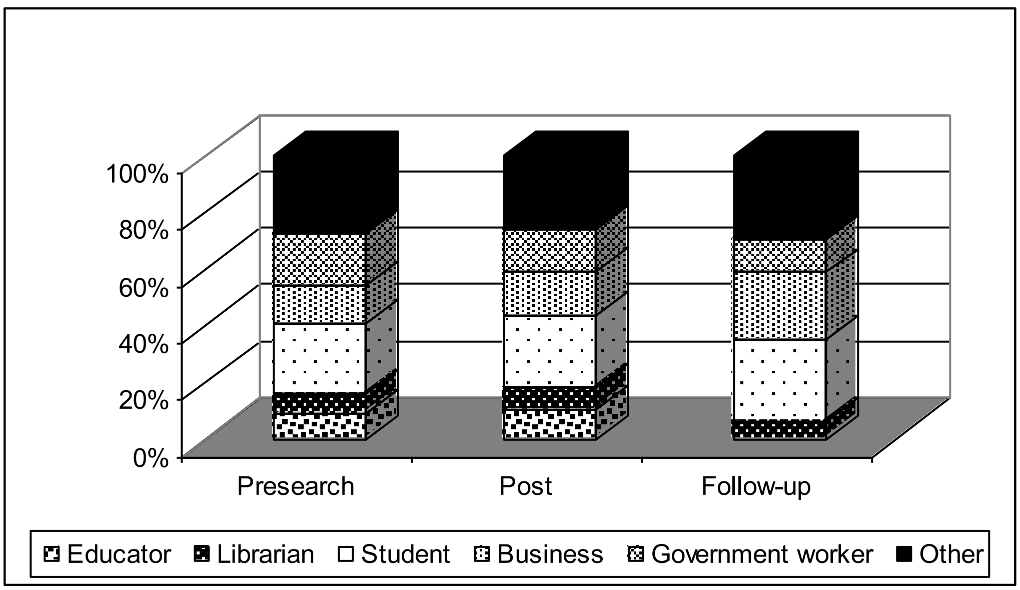
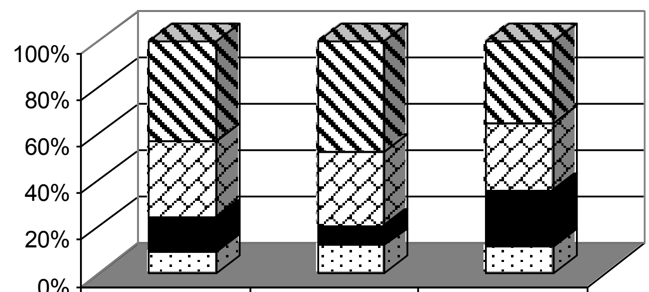


Figure 5.4. The occupation of the participants is depicted here.

The participants were also asked to describe their experience with food preparation. A nominal scale of never, rarely, sometimes, often, or always was used to answer the question, “On average, how many times a week do you prepare, or help to prepare, you(r) main meal of the day?” Again, the percentage of answers in each category at each stage remained relatively even, as is depicted in Figure 5.5.



	Pre-search	Post	Follow-up
Always	18	12	6
Frequently	14	8	5
Sometimes	6	2	4
Rarely	4	3	2

Figure 5.5. Food preparation experience of the sample population at each of the three stages of the experiment.

5.3 The Treatments – Websites Chosen and Rated

The participants searched for and chose Websites that fit their own criteria for quality of the information source and relevance to the topics. One Website was chosen for each topic in accordance with the three scenarios described in Appendix J, but the focus of the knowledge structure analysis was the question found on both the Pre-search and Follow-up instruments, “Describe what you know about food safety issues” (Appendix I, Question 13 and Appendix N, Question 1) . Therefore, just as in the first study in the genetically modified food context (GMFC), the median value of the overall evaluations for all three of the viewed and rated Websites, or treatments, was used as a composite description of the quality of the information sources utilized.

Many of the participants did not follow the instructions to write out the Website URL as required in the WQET (see Appendix K). Fourteen participants wrote URLs that were tied to the search engine that they used either Google.com or Yahoo.com. Some respondents gave the “Google identifier” as the URL for one or more of their Websites. These Google identifiers are related to the search results page. For example, one “URL” was listed as “www.google.com/search?hl-en3g=contaminated + prepackaged lettuce.” The identifier can be used to understand what words the person entered into the search but not what Website they viewed. Several other URLs did not have enough information or were unable to be identified. In total, 23% of the chosen treatments could not be verified. The results in this section are based on the WQETs filled out by the fifteen participants who completed all three parts of the protocol and identified the URLs that they used in some meaningful way. There were a total of 39 Websites; out of these 31 were unique. This group of sites did include two sets of evaluations where the identification of all three Websites was simply the name of the Google search; although the sites cannot be distinguished by name, the participants clearly discriminated between them by providing very different assessments for each. One participant who completed all of the other instruments did not complete a single WQET.

A list of the five Websites that were chosen and rated most often by the participants can be found in Table 5.1. The URLs listed illustrate the difficulty in comparing URLs in this sample. Several participants indicated that they had gone to www.cdc.gov as a general site but others were more explicit in the exact page that they had viewed. A similar problem is caused by the splitting of information from the same source onto multiple Web servers. Participants chose and rated the following URLs:

http://www.ams.usda.gov/,

http://www.csrees.usda.gov/nea/food/in_focus/safety_if_biosecurity.html, and

http://www.fsis.usda.gov.

These were considered to be three different Websites, despite their common sponsor, the U.S. Department of Agriculture. The potential difficulties that this might pose to Web users will be discussed in Section 5.7.

Table 5.1

The Five Websites Most Often Rated by the Participants Showing URL and sponsor

#Times Rated	URL	Sponsor
4	http://www.cdc.gov/ncidod/dbmd/diseaseinfo/listeriosis_g.htm	Centers for Disease Control
3	http://www.fda.gov	Food & Drug Administration
2	http://www.animal-science.org/csg/content/full/82/11/3394	Animal Science (A Journal)
2	http://www.cdc.gov	Centers for Disease Control
2	http://www.scorecard.org/chemical-profiles/edf-risk-characterization.tcl?edf_substance_id=57-74-9	Scorecard (A non-profit organization)

In sharp contrast to the result reported in the last chapter, the majority of the Websites were in the .gov domain. Table 5.2 shows the domain breakdown for the sample.

Table 5.2

Top Level Domains of the 39 Websites Chosen by the FSC Participants

Domain	**Number**	**Percentage**
gov	20	51.3
com	9	23.1
org	7	17.9
edu	3	7.7
Total	39	100

In the FSC, the chosen Websites were given a summary evaluation using a 7-point Likert scale, with 1-2 indicating poor and 7 indicating excellent quality (see Appendix K, Question 15). The mean quality assessments were quite high (5.6) for this group of sites. The variability in the judgments is obscured by the mean as is illustrated in the boxplot in Figure 5.6, where it can be seen that the ratings actually ranged from a low of one to a high of seven. Although the bulk of the Websites were given high scores, as the mean indicated, there were several that were awarded lower scores.

An overall assessment of the credibility of each Website was also added to the WQET (Appendix K, Question 14) as part of the evaluation of authority issues. The mean for this characteristic was also high at 5.9 out of 7. Similar to quality, there was a range as indicated in Figure 5.6.

The strong link between overall quality and credibility is noteworthy. The correlation between the two criteria was strong with a rank order (Spearman rho) correlation of r_s=.783 ($p<.01$) accounting for 61% of the variance. The *53 outlier Website shown in Figure 5.6 has the URL www.kidshealth.org/parent/infections/bacterial_viral/listeria.html.

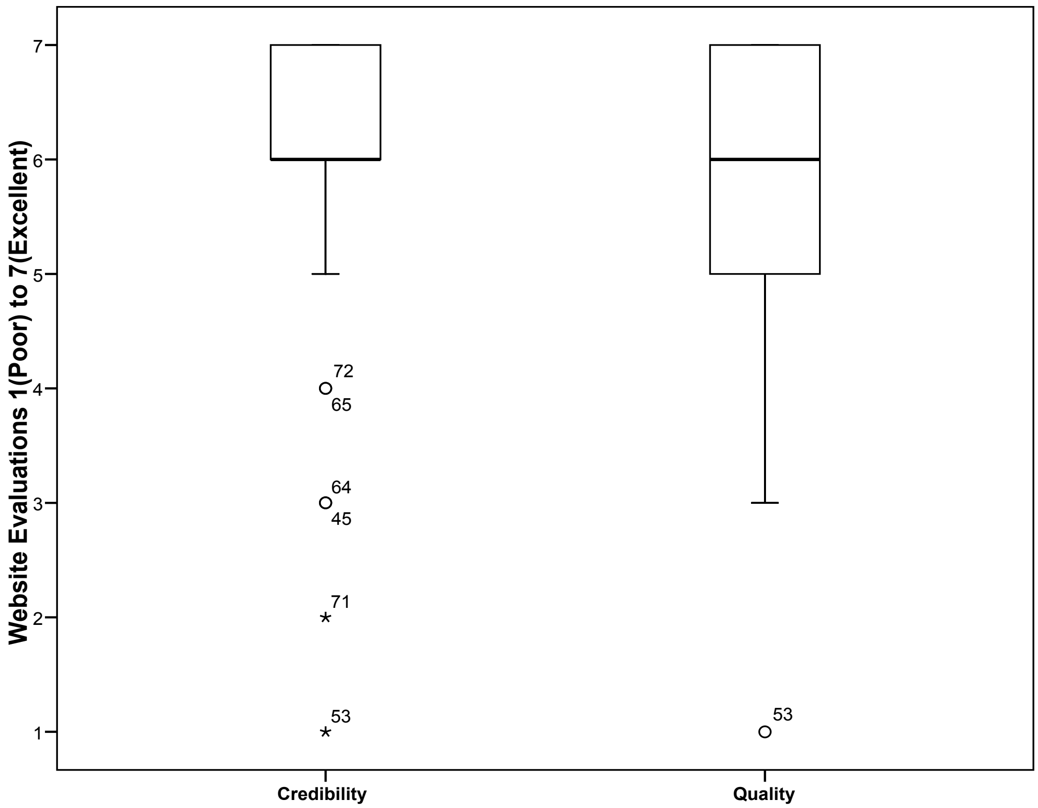


Figure 5.6. Boxplot of evaluations of credibility and quality of the entire sample of Websites (* indicates outlier Websites).

5.4 Changes in Knowledge Structures

5.4.1 Introduction

Research Question 1 was, "How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about a) genetically modified food and *b) food safety?*" Knowledge structures are the internal cohesiveness that people demonstrate by their explication of relational statements in response to questions. This section will explain what instruments were used to obtain explicated statements, how they were analyzed and the general results.

5.4.2 Instruments Used

The Food Safety Context study (FSC) had been designed to examine relational statements produced at three times; 1) the Pre-search stage (see Appendix I), 2) immediately after the searching session was finished using the Post-search questionnaire (see Appendix L), and 3) after two weeks with the Follow-up Survey (Appendix N). Analysis of the results on the Post-search indicated that the questions asked were too detailed to elicit the type of relational statements that could be matched with the question, "Describe what you know about food safety issues" (Question 13 on Appendix I, and Question 1 on Appendix N). For example, Question 2 on the Post-search was, "What would you tell a neighbor about how to look for information about a food recall?" Many of the responses to this question were procedural rather than an indication of what the respondent knew. Therefore, direct comparisons of the explicated knowledge structures using relational statements were only possible between the Pre-search and the Follow-up. The overall results of this analysis are included in this section.

Some questions on the Pre-search (Appendix I Questions 6-10, 11-12, and 15-17) focused on procedural knowledge and emotive issues that did not fit the Research Questions. They were not included in the resulting analysis.

5.4.3 Analysis

The written responses to the "Describe" questions were first parsed into relational statements, defined in the FSC, as in the Genetically Modified Food Context (GMFC) study, as a complete clause with two concepts linked together. For example, one response to the Pre-search "Describe" question was:

> I know for a fact that when handling food you must always keep your hands clean and sanitize. You must also keep hair from being loose and out so that it may not fall into whatever you are cooking. Last every utensil or item you use to must be clean and sanitize. (Participant #28)

The text above was parsed into four relational statements.

1) I know for a fact
2) when handling food you must always keep your hands clean and sanitize.
3) You also must keep hair from being loose and out so that it may not fall into whatever you are cooking.
4) Last [-] every utensil or item you use to[o] must be clean and sanitize.

The statements were then classified into either metacognitive or relational statements. Following the same classification outlined in Chapter 3 and used in Chapter 4, the metacognitive statements, those that were descriptive of knowledge, were designated either deficiency or summative. The relational statements were separated into nine types and were collected into three groups (See Figure 3 for a hierarchy of the classification and Appendix O for a complete description of each category). Table 5.3 provides examples of statements of each of the relational statement types and the corresponding group classification from the participants in the FSC.

Table 5.3

Examples of Relational Statement Coding from the FSC

Code	Example	Participant Number
Fact Classification		
Property	expiration dates	26
Manner	when handling food you must always keep your hands clean and sanitize	28
Set Membership	I am very concerned about the topic [set of concerns]	46
Explanations Classification		
Reasons	[clean cutting boards] This is so that the food doesn't get contaminated.	28
Outcome	You could get salmonella and other diseases	30
Causality	Food may be polluted or poisoned directly, or through farms, crops, water, etc.	44
Implications Classification		
Implications	[we are vulnerable] must do as much as possible to protect ourselves.	26
Generalizations	Germs are everywhere	30
Conclusions	The food chain is a highly vulnerable target.	33

5.4.4 Results

As shown in Table 5.4, there were actually fewer total explicated statements made by the participants on the Follow-up than were made on the Pre-search. Yet, there were four more relational statements written, a small (10%) increase. There was a decrease in the Facts group as a whole, while the Explanations and Implications increased overall. The most interesting increase was in the number of Implications, from five on the Pre-search to ten on the Follow-up for all of the participants. It is also noteworthy that the number of deficiency statements was very low; instead four participants left the Pre-search Question 13 completely blank as is indicated by the No answer category in Table 5.4.

Table 5.4

Number of Explicated Statements (Relational and Metacognitive)

	Pre-search	Follow-up
Total Explicated Statements	**47**	**45**
Relational Statements	**36**	**40**
Facts Total	*20*	*14*
Property	4	2
Manner	15	11
Set Membership	1	1
Explanations Total	*8*	*13*
Reason	1	9
Outcome	3	31
Causality	4	
Implications Total	*8*	*13*
Implications	2	3
Generalizations	2	0
Conclusions	4	10
Metacognitive	**11**	**5**
Deficiency	2	1
Summative	9	4
No answer	**4**	**0**

5.5 Knowledge Structure Changes for Participant Groups

5.5.1 Introduction

Research Question 2 was “In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?” The relationship between the demographic characteristics of the participants and the changes in knowledge structures is explored in this section. Using the data from the knowledge structure analysis, a series of descriptive charts were created for each of the demographic categories, age, gender, educational level, occupation, and food preparation experience. Each will be described in the sections below.

5.5.2 Mean Number of Relational Statements by Demographic Groupings

The mean number of relational statements made by male and female participants during the experiment is shown in Figure 5.7. The number of facts, explanations, and implications did not vary widely at the Pre-search stage. On the Follow-up the mean number of statements written by female participants was higher in all three categories than for the males. This result is reflected in the higher total number of relational statements made by the female participants on the Follow-up instrument. Only one participant did not respond to the gender question, therefore the means shown here are quite skewed. The differences between the means for males and females were not statistically significant according to the independent samples t-test used.

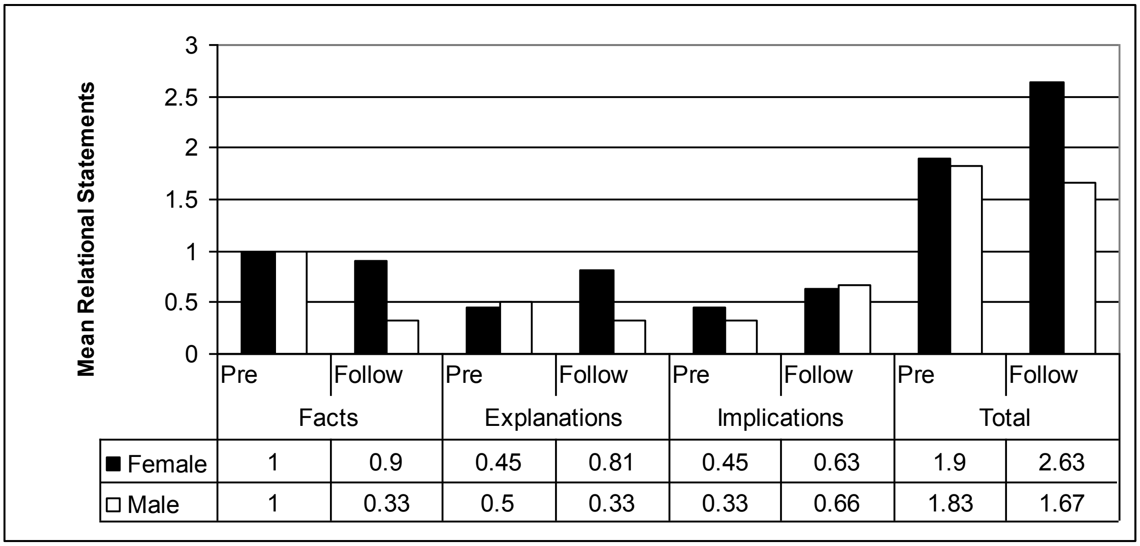
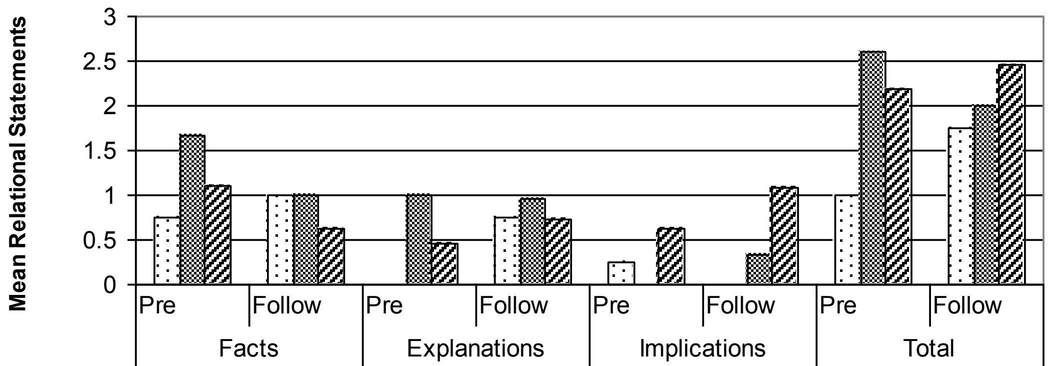


Figure 5.7. Mean number of relational statements by type and by gender of the participants.

Some differences were found in the type and number of relational statements written by the participants in the various age groups represented in the sample. The youngest participants, those aged 18-21, wrote out facts, explanations, and a small number of implications. By the Follow-up, Implications had disappeared and the facts and explanations remained. A similar pattern can be shown to apply to the 22-30 age group with the exception of the implications that started out at zero and grew to 0.33 mean statements. The biggest change in the number of implications was found in the over-50 age group. The participants in this group started out with a mean at 0.63 and ended with a mean of 1.09 implications statements on the Follow-up. These results can be seen clearly by examining Figure 5.8. None of these differences rose to the level of statistical significance as measured by one-way ANOVA.



	Facts Pre	Facts Follow	Explanations Pre	Explanations Follow	Implications Pre	Implications Follow	Total Pre	Total Follow
18-21	0.75	1	0	0.75	0.25	0	1	1.75
22-30	1.671	1	1	0.96	0	0.33	2.6	2
over 50	1.1	0.63	0.45	0.72	0.63	1.09	2.18	2.45

Figure 5.8. Mean relational statements by age groups on Pre-search and Follow-up instruments.

Educational level of the participants did make a difference in the type and number of relational statements explicated on the Pre-search and Follow-up (see figure 5.9). The mean number of relational statements was higher for those with some college education. When the number of Implications statements were considered separately in a one-way ANOVA analysis the difference between the groups was significant ($F = 2.604$, df=2/17). The boxplot in Figure 5.10 shows that those with post-graduate education degrees produced more Implications statements than those with only high school or four-year degrees.

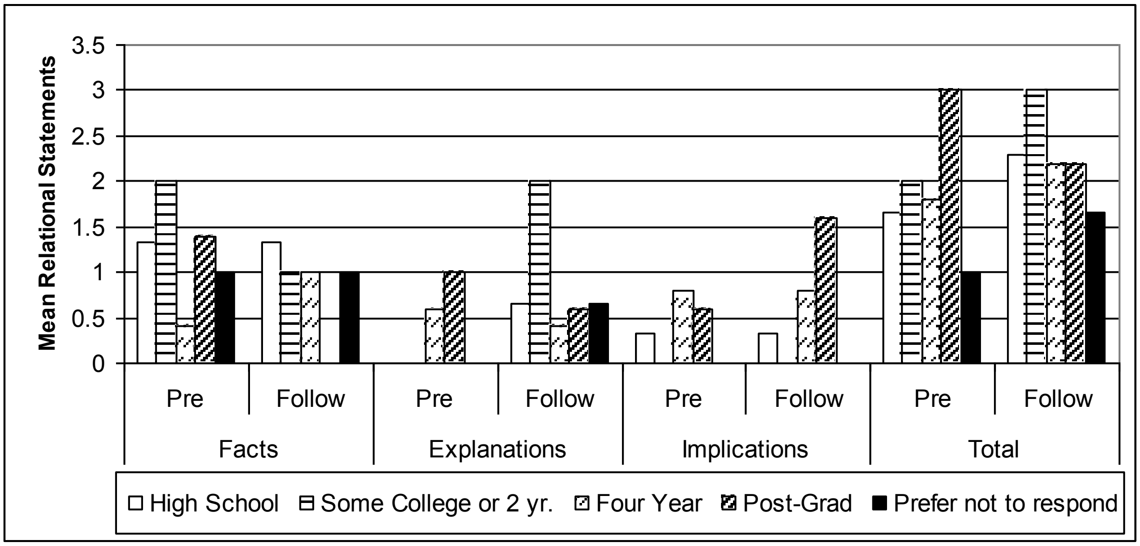


Figure 5.9. Mean number of relational statements separated by educational level and type.

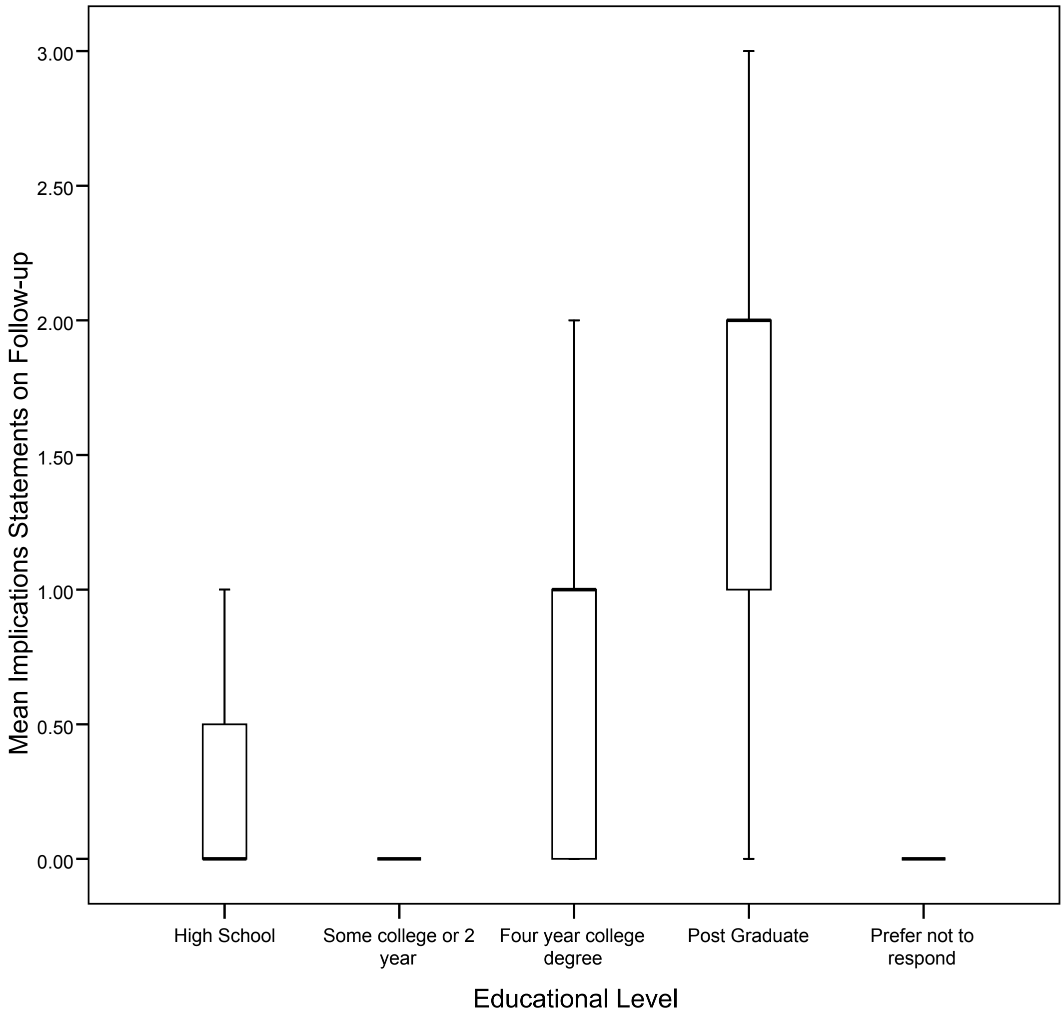


Figure 5.10. Boxplot of the mean number of Implications statements made by participants from different educational backgrounds on the Follow-up instrument.

There were no significant differences in the number and type of relational statements made by the occupational groups represented in this sample. The descriptive differences are shown in Figure 5.11.

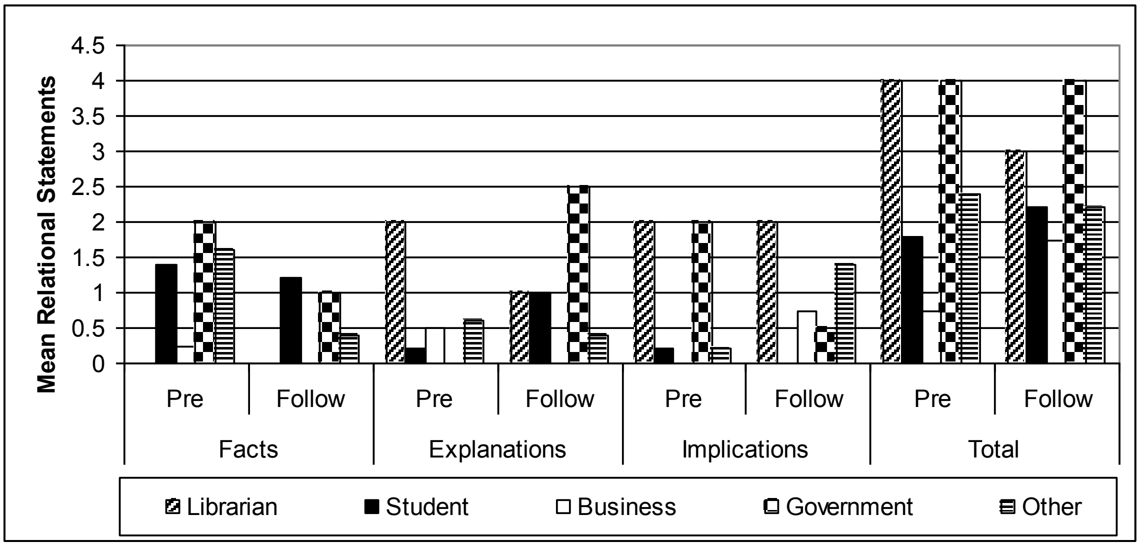


Figure 5.11. Mean number of relational statements shown by type and occupation of the participant.

There were also no statistically significant differences between the mean number of relational statements at Pre-search and Follow-up when the amount of food preparation experience that the participant reported on the Pre-search was considered. Still, a difference in type of statement made can be seen by examining Figure 5.12 where it is shown that while people who rarely prepared food were able to produce Fact and Explanations statements at both the Pre-search and Follow-up stages, those with more experience produced Implications at both stages.

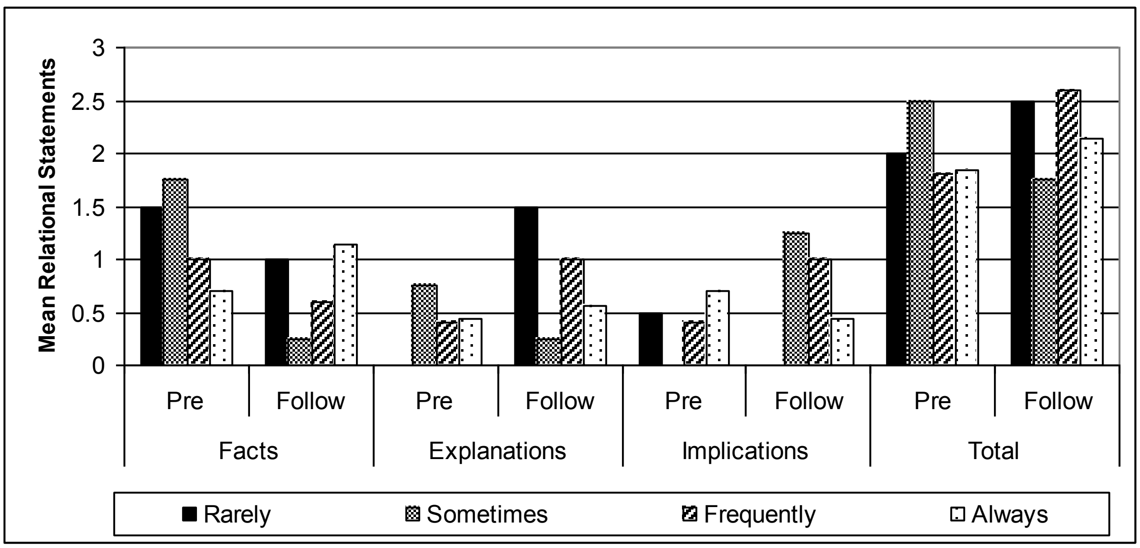


Figure 5.12. Mean number of relational statements made by participants who reported their experience with food preparation to be rarely, sometimes, frequently, or always.

5.5.3 Change in Metacognitive Statements

The difference between the mean number of deficiency and summative metacognitive statements on the Pre-search and the Follow-up was compared using the paired samples T-test. The differences were not statistically significant. There was another category of statement in this study that was used because many participants did not answer the Pre-search Question 13, “Describe what you know about food safety issues.” In fact, four (22%) of the participants that completed the same question on the Follow-up (Appendix N, Question 1) had no response to the Pre-search question. If a growth from no explicated response to some response indicates a growth in knowledge from nothing to something for the group as a whole, then the change is significant as indicated by a paired samples T-test, $t=2.2(17)$, $p<.05$.

5.5.4 Accuracy of Statements

All explicated statements written in response to the “Describe” question on the Pre-search and Follow-up instruments that were not opinions or beliefs were rated as either inaccurate or accurate by the researcher. As can be seen by examining Figure 5.13, there was a slight negative change in the percentage of accurate statements made by the participants while the number of inaccurate statements increased slightly. There was no change in the number of statements that could not be rated because they were opinions or beliefs.

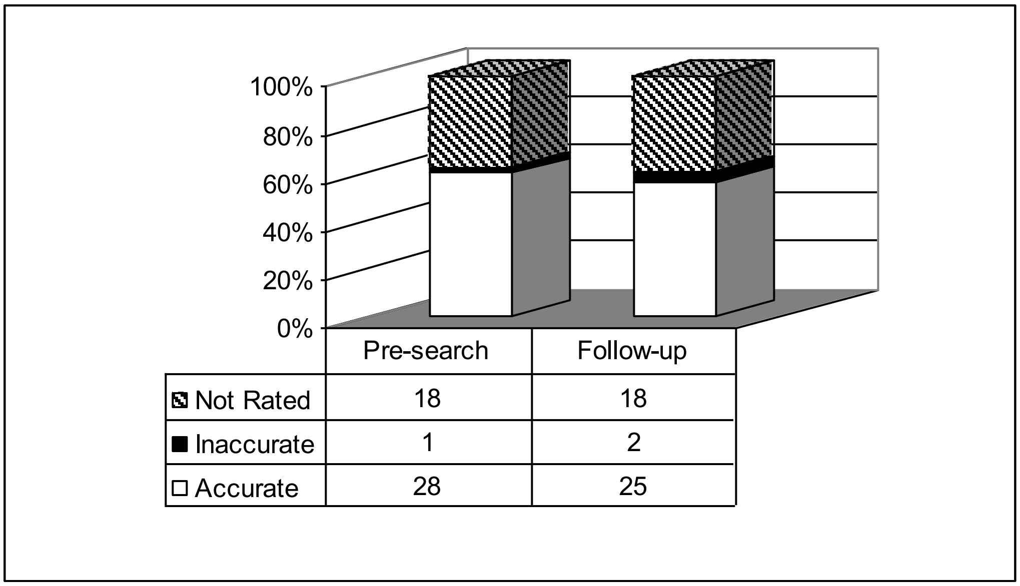


Figure 5.13. Accuracy of explicated statements made by participants is illustrated above.

5.5.5 Extent of Topic Knowledge Change

In the FSC, extent of topic knowledge change was examined by looking at the individual patterns of relational statement production. There were six participants, or 35% of the sample, who either did not respond to the statement, “Describe what you know about food safety issues.” (Question 13, Appendix I) or answered it with a metacognitive statement like “only what I hear on the news” (Participant #2). These initial statements were compared to the types of statements that these same participants made on the Follow-up instrument in answer to the same question (see Appendix N, Question 1). Four of the six participants, or 66% of the group that didn’t respond, were able to make a Fact statement on the Follow-up. As an illustration of this pattern, Participant 1 wrote no answer on the Pre-search and then produced the following: “I know that some prepackage (sic) is not safe [for] humans an example of a Fact statement.

Only one participant from this initial “no-answer” group, or 17%, was able to make a Reasons statement, while one other participant wrote out both a Fact statement and two Implications statements on the Follow-up. This last respondent, Participant #19, wrote a metacognitive statement on the Pre-search, “[I know] What I hear on the news or what I read on food product labels (sell by dates, refrigerate, etc.” On the Follow-up, she or he wrote three relational statements; the texts of these are printed below followed by the classification of the statement in parentheses.

> Statement #1. “Although foods are under guidelines of USDA, FDA etc., consumers still need to be aware of food safety. (Implications statement)
>
> Statement #2. “Consumers should pay attention to storage conditions and use by dates as per package instructions. (Facts statement)

Statement #3. “The Bioterrorism Act has put more restrictions on food processors making it more difficult (though not impossible) for the U.S. food supply to be tampered with by terrorists. (Implications statement)

For both respondents whose statements are reproduced above, an increase in the extent of explicated knowledge can be discerned. Another way to demonstrate such an increase for the entire group is to examine and compare pre-and follow-up statements for the group of participants who were able to produce Implications type statements at the final stage. Eight of the seventeen participants (47%) wrote at least one implication, generalization, or conclusion statement on the Follow-up instrument. Three of these participants also wrote Implications statements on the Pre-search, but the other four started with either Facts or Explanations. The change from Facts to Implications can be illustrated by looking at the relational productions of Participant #4. On the Pre-search, she or he wrote three statements, all in the Fact classification (Manner type). These are:

Pre-search Statement #1. “Avoid spoilage,”

Pre-search Statement #2. “consider additives;”

Pre-search statement #3. “avoid contamination”

She or he wrote only one statement on the Follow-up, as below:

Follow-up statement. “Food safety is an issue in all phases of food pipeline from growing crops or raising food animals through harvesting or slaughter, subsequent storage, processing, packaging, and preparation and storage by consumer.”

5.5.6 Summary

The knowledge structure changes were examined in terms of relational statement production, accuracy, and extent. Although most changes were not statistically significant over the entire group, education level was an exception, with those that completed post-graduate work able to produce more relational statements than those who completed only high school or college. There was also a significant difference between those who made no statement on the Pre-search and their ability to produce some kind of statement on the Follow-up. This result was not reflected in increased accuracy, however, with the percentage of inaccurate statements increasing by the time of the Follow-up. Extent of knowledge change was not examined by number but by looking at the actual text of statements made by those whose statements on the Follow-up differed in classification from those made on the Pre-search. These results will be examined more fully in the discussion in Section 5.7.

5.6 Quality Ratings and Knowledge Structures

5.6.1 Introduction

The results reported in this section relate to Research Question 3: How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all? First, the correlation between quality or credibility and the measured demographic variables, age, gender, education, work and food preparation experience, was examined. Then, the relationship between knowledge structures exhibited on the Follow-up and quality and credibility judgments was explored

5.6.2 Quality and Credibility Assessments Related to Demographics

None of the demographic measures correlated in a statistically significant manner with quality; however, both gender and food preparation experience were associated with credibility judgments. The rank order correlation (Spearman's rho) for gender and credibility was weak at r_s= .489 ($p<.10$), or 24% of the variance. Food preparation experience, on the other hand, had a strong inverse correlation with a Spearman's rho calculation of r_s=-.508 ($p<.05$), or 26% of the variance. The relationship between food preparation experience and credibility can be viewed in the in Figure 5.14. This figure shows that with more food preparation experience, where respondents answered that they "always" fixed the food in their families, there were lower scores on credibility for the Websites visited.

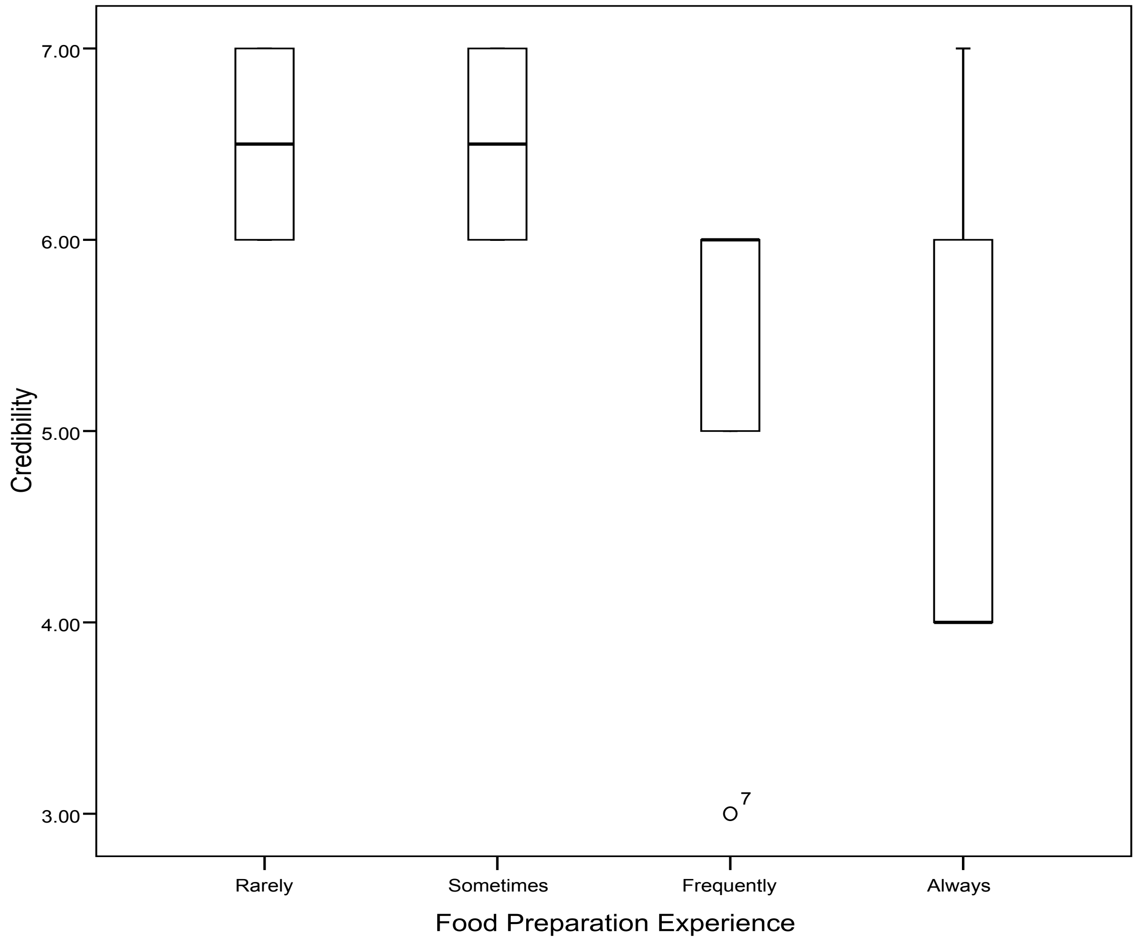


Figure 5.14. Boxplot of food preparation experience is inversely correlated with credibility (º7 is an outlier participant answer).

5.6.3 Knowledge Structures Related to Quality and Credibility Assessments

In order to explore the relationship between quality assessments of Websites and the resulting exhibited knowledge structures, a series of correlation tests were run between the mean quality ratings of the three viewed Websites and the relational statement group classifications, i.e., Facts, Reasons, and Implications (see Appendix O and Section 3.4). Only Facts and quality had a statistically significant rank order relationship (Spearman's rho) of r_s=-.583 ($p<.05$) that described 34% of the variance. This relationship is viewed profitably by examining the boxplot of the two variables shown in Figure 5.15. The participants who rated their Websites as being only four in quality produced more Fact statements when compared to those who made rated their Websites as either six or seven in quality.

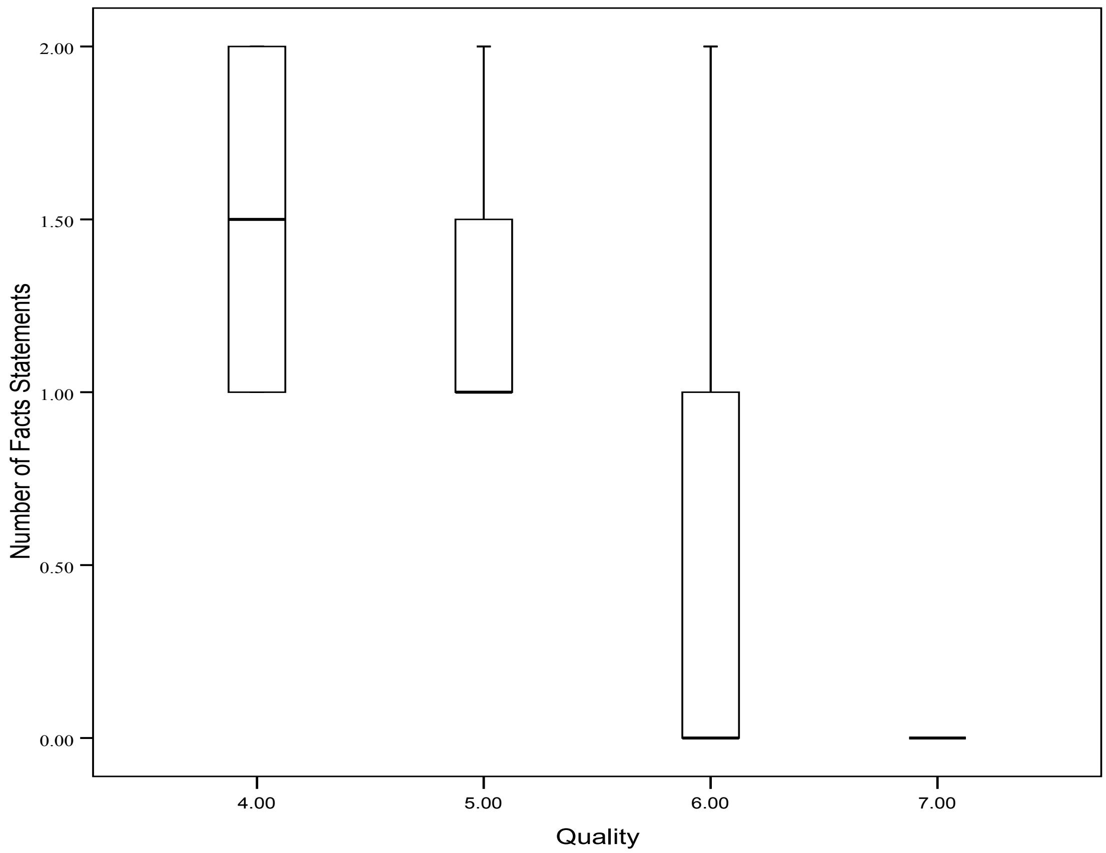


Figure 5.15. Boxplot of relationship between quality and production of Facts relational statements.

A second interesting relationship was found to exist between Implications statements made and Website quality as can be seen by looking at the boxplot in Figure 5.16. Though this correlation was not statistically significant, due to the low numbers of participants awarding low quality assessments, it can be seen here that those who viewed what they considered to be higher quality Websites produced more Implications statements.

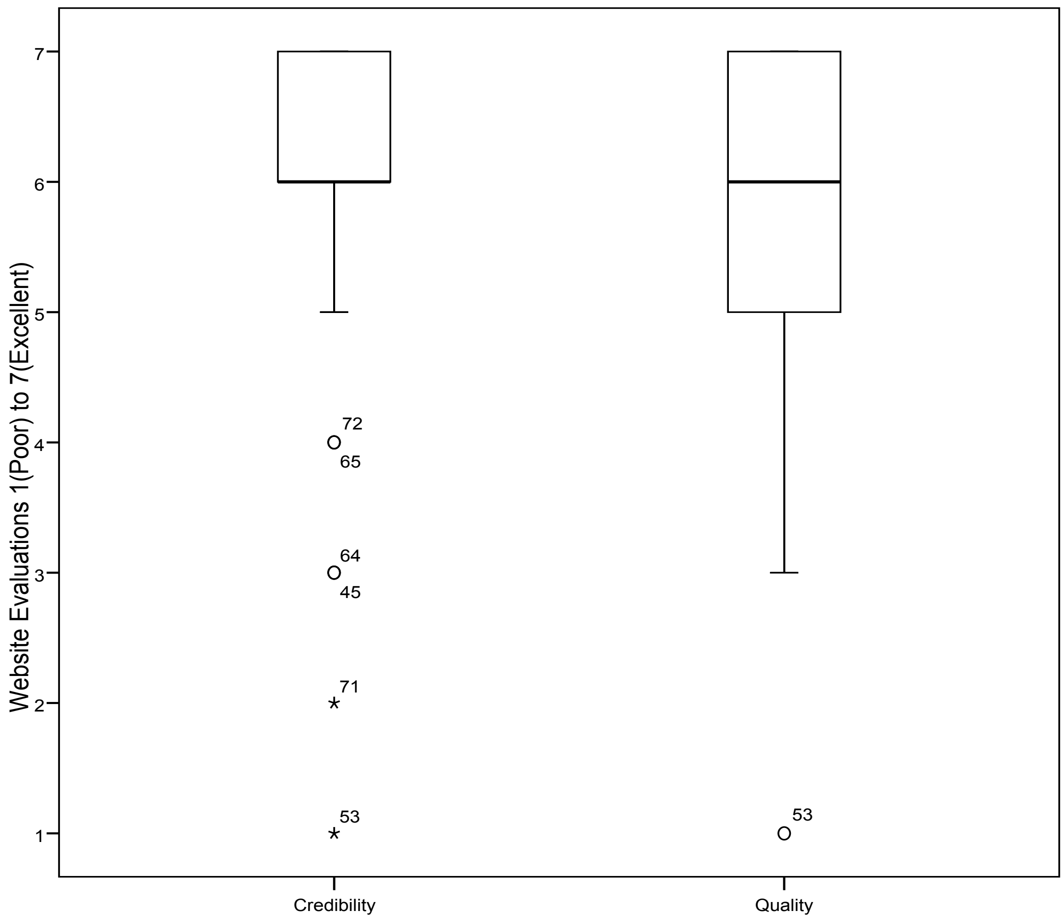


Figure 5.16. Boxplot showing that participants who rated their Websites as 7 (excellent) produced more Implications statements than those who gave lower ratings (* indicates outlier Websites).

Credibility was not correlated in a statistically significant way with total relational statement production. A weak inverse relationship between credibility and Fact statement production was found that mirrored the relationship between this type of statement and quality.

5.6.4 Summary

Website quality ratings were not correlated with any of the demographic characteristics reported by the participants on the Pre-search instrument. Credibility assessments were weakly linked to gender, and surprisingly, strongly and inversely related to food preparation experience. Female participants were more likely to rate credibility higher than males in this sample. Those with more food preparation experience were more likely to give lower credibility ratings to the Websites that they viewed. More importantly, low quality scores were linked significantly to the production of more Facts statements. There was no link between credibility and relational statement explication. Further discussion of these results will be found in the next section.

5.7 Discussion of Findings

The pattern of participation in the study of information utilization in the food safety context (FSC) was concordant with the call from Hargittai and Hinnant (2006) to reach out to populations beyond the university for participants in Information Science research. A broad range of educational, occupational, and food preparation experiences were represented in the sample of participants. Since participants were volunteers, females outnumbered males three to one, and this proportion held from the Pre-search instrument through the Follow-up. The age range was dichotomous between those 18-30 and over 50 being best represented in the final sample. The lower number of respondents on the Follow-up survey, only 36% of the original group, can be attributed to the long protocol and the difficulty of contacting people to complete the Follow-up instrument.

The Websites chosen by the participants were primarily in the .gov or government domain. Few were chosen by more than one participant. The problem of identifying a Website is a serious one for these everyday life information seekers. Writing Google.com or Yahoo.com in the space for the URL may mean that the respondents never actually left the Google results page and were using the WQET to rate Google or Yahoo. An alternative explanation would be that since the ratings given to these "Websites" were unique, they may have gone to the actual site and then used the identifier from the results page to label it after the fact. Disorientation may also be caused by the multiple servers used by government departments and agencies. If the process of quality and credibility assessment is going to be automated, the results in this study show the difficulty of using the domain name as a direct link to the authorship of the Web object. Certainly, how these participants understand where they are on the Web requires further research.

The influence of some demographic characteristics on the type of relational statements explicated was seen in this study. Older participants wrote a higher mean number of Implications type statements on the Follow-up than both the 18-21 year old group and the 22-30 year old group. The higher number of Implications statements for older people may reflect their higher level of confidence in their knowledge, or it may show their higher level of education. Certainly, there was a statistically significant difference between the mean numbers of Implications statements written by those with higher education levels than those with less education. The ability to produce Implications statements was not simply an artifact of being presently engaged in educational pursuits at the time of the experiments, since few of the participants were students; instead it may show a lasting impact of level of education when dealing with newly encountered sources.

Using the changes in relational statement production to look at extent of topic knowledge change in individual participants was fruitful. The results seem to confirm work by Todd (2006) who found that early statements of topic knowledge are more often classified as Facts and tend to be more plentiful than later ones. Statements about a topic produced after some time tended to be Implications and there were fewer of them than were found on the first writing instrument given in that study. Certainly, Participant #4's relational statements written for this study follow that pattern. Other participants showed changes from no response to Facts and from metacognitive generalities to an ability to create true relational statements about the topic.

The connection between quality of Website sources used in this study and the credibility of those sources was statistically significant in this study. The pattern of awarding a rating on these two characteristics was in the main unrelated to demographics, except for a weak and positive connection to gender and a strong and inverse relationship to food preparation experience. Those participants who rarely or sometimes prepared food for the main meal in their household were much more likely to rate their Websites as more credible than those who frequently or always prepared that meal. It may be that firsthand knowledge creates a deeper level of skepticism for second-hand knowledge (Wilson, 1983). In other words, respondents with real world experience with food are less tolerant of claims made by Website authors.

Relational statement production was tied only to judgments about the quality of the Website sources viewed. Those who rated the Websites that they viewed as low quality were significantly more likely to produce Facts statements, while those who gave higher quality ratings produced more Implications statements. This result may indicate that higher quality sources led to more intricate relational statements. An alternative explanation may be that those who were capable of producing Implications statements were also better able to choose higher quality Websites and, therefore, rated them as such. The data collected in this study does not help to clarify this distinction.

It is interesting to note that though credibility and quality are statistically related, they are not both related to knowledge structure building. As Wilson (1983) notes, credibility is one part of cognitive authority, which in turn, is a part of a quality assessment of a source. Yet, he also notes that something can be credible but not have an influence over the reader. The findings reported here may confirm the relationship between credibility and cognitive authority experimentally. Something can be deemed believable, as the majority of the Websites viewed in this study were, but still not have influence and, therefore, cognitive authority for the reader. Influence, according to Wilson (1983), leads to an action on the part of the information seeker. An influential source will produce a change in behavior toward a topic. As measured in this study, influence would be seen in more Implications statement production.

In the next chapter, the two studies that are included in this dissertation will be considered together, so that conclusions and implications may be drawn from them.

CHAPTER 6: CONCLUSIONS AND IMPLICATIONS

6.1 Introduction

The two studies described in the preceding chapters, the Genetically Modified Food Context (GMFC) study in Chapter 4 and the Food Safety Context (FSC) study in Chapter 5, examined information utilization within two food related contexts by analyzing the knowledge structures of everyday life information seekers before and after the use of Web resources on these topics. The discussion sections in each chapter outlined the major findings and set them within the body of other research in Information Science and Science Communication. In this chapter, conclusions will be drawn from those findings that are related to the three initial Research Questions. An outline of these conclusions is found in Table 6 with major findings in order as they appear in the discussion in Sections 6.2 through 6.4. The limitations of the two studies will then be discussed, followed by a section on the implications of the research findings for practice and research. Suggestions for possible research avenues that proceed directly from the implications will be described in the final section.

Table 6

Summary of Major Findings Related to the Research Questions

Research Question	**Findings**
RQ1. How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about a) genetically modified food and b) food safety?	Between the Pre-test and the Follow-up: 1. The total number of participant produced relational statements increased in both studies. 2. The number of metacognitive deficiency statements decreased in both studies. 3. Extent of topic knowledge increased in both studies. 4. Accuracy decreased or stayed the same in both studies.
RQ2. In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?	1. In the GMFC, University affiliates produced more Implications on the Follow-up than partipants who were not. 2. In the FSC, participants with a higher level of education produced more Implications statements on both Pre-search and Follow-up. 3. In the FSC, those who had more food preparation experience produced more Implications statements at both Pre-search and Follow-up.
RQ3. How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all?	1. In the GMFC, participants who used Websites with low Graphics ratings produced more relational statements on the Follow-up. 2. In the FSC, utilization of low quality rated Websites was associated with production of Facts statements, while high quality was associated with Implications statements on the Follow-up. 3. Quality and credibility were statistically correlated with each other.

6.2 Knowledge Change

RQ1: How do knowledge structures change, if in any way, for everyday life information seeking adults interacting with Web resources about a) genetically modified food or b) food safety?

Knowledge structure change was determined in both studies by analyzing the written, explicated statements of participants in answer to the questions asked at the Pre-search and Follow-up stages: "Describe what you know about…," (Appendix D, Question 7 and Appendix G, Question 4; Appendix I, Question 13 and Appendix N, Question 1). All of the explicated statements were categorized as either metacognitive or declarative. The metacognitive statements were further labeled as deficiency, indicating a lack, as in "Nothing," or summative, a summary description of knowledge, as in "I know how they are made." The declarative statements were parsed into shorter, relational statements marked by clauses where two concepts were in relationship with each other. Using the classification scheme depicted in Figure 3 and described in Sections 4.4 and 5.4, the relational statements were categorized and grouped (see Appendix O for more information on the basis of this analysis). An overview of the resulting classification of the statements and a description of other knowledge change indicators, i.e., both accuracy and extent, will be discussed in this section.

An overall increase in total number of explicated statements written on the Follow-up instrument as compared to the Pre-search was evident in both the GMFC and FSC studies (see Tables 4.4 and 5.4). Although a total count is a crude measure, the increase in numbers certainly indicates that a change of some type occurred after the treatments were selected and viewed. The pattern of change in type and classification of statements was different in each study.

Participants wrote fewer metacognitive statements at the Follow-up stage in both studies. In the GMFC, the total was only lower by one, but there was a complete reversal of type of metacognitive statement from deficiency to summative. Generally, GMFC participants who described their knowledge as lacking at the Pre-search stage were able to explicate at least a summary of information that they encountered in the searching session. In the FSC, the total number of metacognitive statements made by the participants decreased by more than half, from the Pre-search to the Follow-up stage. Additionally, the statements made on the Pre-search instrument were summative metacognitive rather than deficiency metacognitive. Also, in the FSC, there was another indicator of knowledge change. Four of the participants wrote no response at all to the initial question on the Pre-search instrument but all wrote something on the Follow-up instrument.

Examined together the metacognitive statement differences in the two studies do show knowledge change, but these results could also point to a fundamental difference in the two topics. GMFC participants were less familiar with the topic of genetically modified foods than the FSC participants were with food safety, at the start. The FSC participants were generally able to produce summative metacognitive statements at the Pre-search stage while the GMFC participants wrote deficiency metacognitive statements when they did not write any kind of relational statement at this same stage. The lack of knowledge about genetically modified food found at Pre-search stage in the GMFC mirrored that found in two large phone surveys done during the same period that the study protocol for the GMFC was completed (Hallman et al., 2002; Hallman, et al, 2003; Hallman et al., 2004).

The non-responses in the FSC are less easily explained. There appears to be a difference between a metacognitive deficiency statement and a non-response that could be associated with the generally higher education level of the GMFC participants. The more educated participants may have felt that writing out the words “nothing” or “not much” is preferable to a non-response to a question. Nevertheless, the FSC non-respondents exhibited more confidence in what they could write about their topic knowledge by the time that the Follow-up instrument was done. They did, in fact, make comments on the Follow-up survey.

The observed changes in the numbers of both non-responses and metacognitive deficiency statements support the conclusions by researchers in the area of public understanding of science (Roth & Barton, 2004; Wynne, 1995, 1996) that surveys and quizzes do not adequately measure scientific literacy regarding either general or specific topics. The inadequacy of quizzes was particularly clear in the GMFC where deficiency statements were sometimes followed by accurate relational statements. It seemed that some of the GMFC participants discounted their knowledge initially on the Pre-search instrument and then became more expansive. During a phone survey quiz like those given by the National Science Foundation or other agencies (Hallman, et al., 2003, 2004; National Science Board, 2004), an initial “I don’t know” response would be more difficult to correct than is the case with the open-ended written question format used in the GMFC. When given a chance to expand upon what they know, survey participants may actually exhibit much more science literacy than a simple phone survey could show.

The type of relational statements made at the Follow-up stage compared to the Pre-search stage also changed in both studies. In the GMFC, there were more Facts statements written by the participants on the Follow-up instrument accompanied by a slight increase in Implications statements. At the same time, in the GMFC, the number of Explanation statements decreased. In contrast, the participants in the FSC wrote fewer Facts statements at the Follow-up stage and their Explanations and Implications statements increased. None of the changes in quantity of statements for any type or group classifications were statistically significant.

The general changes described above are further evidence to support the earlier contention that at the Pre-searching stage genetically modified food was much less well known to the participants in the GMFC than Food Safety was to the participants in the FSC. The GMFC participants accumulated and explicated more Facts on the Follow-up because they started with lower familiarity. In contrast, the FSC participants were able to construct more Explanation and Implications statements on the Follow-up instrument because they started with a larger knowledge base. The reasons for the greater topic knowledge for the FSC participants will be explored further in Section 6.3.

The knowledge structures evidenced in the two studies may reflect the classic Taxonomy of Educational Objectives (Bloom, Krathwohl, and Masia, 1956-1964), but it is unknown if that taxonomy, designed, as it was, for formal educational objectives would be useful to understand the explicated statements from the GMFC and FSC. Indeed, the

GMFC and FSC protocols were designed to study participants in less formal learning situations. It should be said, however, that the Todd (2006) framework was inspired in part on Bloom's taxonomy. Further study would have to be done to reconcile the informal learning situations of the two protocols with the formal objectives of Bloom's taxonomy. A comparison study might be devised in further research that might accomplish this objective.

The increase in number and types of relational statements did not correlate with a positive change in accuracy in the GMFC. In fact, the number of inaccurate statements made in that study remained the same. In the FSC, inaccurate statements actually increased slightly. Relational statement analysis was useful for revealing the structure of declarative knowledge, but it did not illuminate the topical content accuracy.

There seems to be little reason for a decrease in accuracy while extent and number of relational statements increased. Perhaps there was an addition of new wrong information that disrupted the participants' knowledge structures and produced more statements. The situation may have been related to the timing of the Follow-up; there may not have been enough time for the new wrong information to be rejected by the participants. More research is called for that would disambiguate these speculations.

Relational statement analysis was related to the extent of topic knowledge. Knowledge extent was measured in the GMFC by using the assessments of outside coders. In general, there was an increase in the number of participants who could reveal some knowledge of the topic, and the number that showed little knowledge decreased by the time the Follow-up was completed. In the FSC, using a detailed analysis of the change in the character of statements for individual participants showed that there was an overall increase in the extent of knowledge.

The explicated statements made after the searching sessions by the participants in both studies indicated a change in knowledge structures. Generally, the searching sessions contributed to changes in the type of statement made and to extent of knowledge of the participants. The accuracy exhibited by the participants was either unchanged or decreased depending on the study. The relationship between the changes found and the demographic information collected in the two studies is the subject of the next section.

6.3 Demographic Effects on Knowledge Change

RQ2. In what way, if any, do demographic variables affect the formation of knowledge structures after a Web searching experience?

The total number and type of relational statements made by respondents changed in both the GMFC and the FSC. For the most part, the mean changes were not related in a statistically significant way to the demographic variables that were collected in those studies. The primary exception in the GMFC was the difference in total number of relational statements made by participants who identified themselves as university students and those who indicated that they were not affiliated. Interestingly, the demographic factors that might have been considered to be part of this broad characteristic, namely, educational level and age, were not significantly related to these changes in relational statement type. The influencing factor contained in identifying as a University affiliate may be the level of engagement or chronological proximity of the engagement in educational activities. It can be concluded, however, that studies of everyday life information seekers cannot be done within a university community. Whatever the source of the University affiliate influence, it is clear that university students are different from those outside the Academy, as proposed by Hargitai and Hinnant (2006).

In the FSC, university status was not a factor because all of the participants were not affiliated with the University itself. Interestingly, age differences had some effect on the types of relational statements written. People over 50 had a much higher mean production of Implications statements than other age groups.

Educational level differences were statistically significant in the FSC. Those with only a high school level education produced a much lower mean number of Implications statements than those who had a post-graduate education. The mean number of Implications statements for four-year college graduates was between high school and post-graduate level. Though not surprising, the link between educational level and production of Implications statements reinforces, once again, the importance of conducting research with people who are not involved in a university setting. Participants with a wide range of educational preparation provided a more realistic picture of how a Web searching session may influence information utilization on a particular health or science topic.

The most important demographic link found in the two studies was that between food preparation experience and relational statement production. Participants in the FSC who rarely prepared dinner produced no Implications statements before and few after Web searching, while those who at least sometimes prepared dinner could produce

Implications statements both before and after the searching sessions. First-hand experience with a topic in this study, therefore, had an effect on the knowledge structures that existed before the protocol began and the way that information from the chosen resources was utilized. As Wilson's (1983) work implies, interaction with only second-hand texts may not be useful when an individual has no first-hand experience on which to build. The public understanding model in science education is also based on this premise (Roth & Barton, 2004).

The conceptual model assumed that demographic characteristics of the participants would impact information utilization. Most of the examined variables, including gender, age, and occupation did not have statistically measurable effects. The positive correlation between the multi-faceted characteristic, university status, used in the GMFC, was probably most influenced by educational level, as seen in the FSC. The effect of food preparation experience found in the FSC was interesting and will be elaborated upon in the next section on the impact of Website quality.

6.4 Relationship between Website Quality and Knowledge Change

RQ3. How does the quality of a Web resource as assessed by an everyday life information seeker affect the formation of knowledge structures after utilization of that resource, if at all?

In order to understand the impact of Website quality on knowledge structure building in the two studies, it is important to examine the characteristics of the chosen Websites, or as used in this dissertation, the treatments. There were two ways to examine them in the two studies: by looking at the descriptive characteristics, i.e. the domain of the Website, the title and the author, and by the ratings awarded to them by the participants using the WQET instruments.

In both studies, the participants were asked to write down the URL, or Universal Resource Locator, the title, and the author of the Website. The accuracy of these descriptive elements varied widely among the participants. Many times it was difficult to ascertain exactly what Website the participant had viewed. It is possible that the identification problem might have been solved by the use of software to record the search sessions and, therefore, the Websites that people visit. This technique is commonly employed in Information Science research. The method allows the researcher to view exactly what Website was visited; however, he or she would still not know what was read and therefore available to be utilized. If eye-tracking software were used to record what was read, then the researcher would still not know what was absorbed. In all information utilization research, then, the researcher is left with what the participant says about the source that is the object of the study. In this dissertation, the treatment is taken to be the Website that was described by the participant on the WQET instrument. The quality descriptions were assumed to be tied to particular Websites with corresponding quality as assigned by the participants.

It was known from the WQET descriptions, then, that the domain of the Web resources chosen by the GMFC participants as the best sites was primarily .com. These choices contradicted survey research that generally shows that people would choose .gov or .edu sites more often when considering a health or science topic (Liu, 2004; Treise, Walsh-Childers, Weigold, & Friedman, 2003). During the FSC, the opposite result was obtained. In the FSC, the Websites chosen were primarily .gov or .edu, a result that verified the prior research. The nature of the two topics may explain this difference between the domains of the Websites chosen in the GMFC and those chosen in the FSC. During the time that the GMFC was conducted, a wide variety of commercial entities were concerned with genetically modified food. There were a number of groups supporting its use, along with a number of other groups opposing its use. Food safety has few commercial ties with the exception of law firms that specialize in foodborne illness litigation, even though a number of companies are affected by problems encountered in distributing unadulterated food. The government and educational institutions may be the only sites that were available to the FSC participants, a conjecture that is supported by the fact that participants chose many of the same Websites to rate. Reconciling the contradictions in the findings requires reference to the concept of satisficing (Agosto, 2002; Prabha, et al., 2007, Simon, 1956). The participants in previous survey research may have been able to make the most rational and considered choice about the type of source they would consider appropriate for providing information about science and health (Liu, 2004; Treise, Walsh-Childers, Weigold & Friedman, 2003). Faced with particular choices, however, as in the GMFC and the FSC, participants chose what came easiest at hand or what seemed best at the time. Satisficing would also explain the clustering of the FSC participants choices around the same few Websites. They chose from what was made available to them through the search engine listing. Time limitations and other considerations may have prevented them from pursuing the search further. In the end, they were satisficed with what they had found and used it.

In the GMFC, individual characteristic ratings of the Websites were used to indicate quality. The scores on these characteristics could not be averaged because they were based on ordinal scales. Using this limited tool, only characteristic “graphics” was shown to have a significant effect on the quantity of relational statements made by the participants. Those who noted that the graphics factor was poor wrote fewer statements on the Follow-up than those who thought that the graphics were of high quality. There were no detectable effects on relational statements based on the authority rating awarded to the Websites by the participants.

In the FSC, an overall quality rating was awarded to Websites by the participants using a 7-point Likert scale. The rating was used in the analysis as a general quality indicator for a series of correlations between quality and final knowledge structures, as measured by the relational statement classification. It was found that there was a statistically significant link between Fact production and low quality Website ratings. Participants who rated the Websites that they viewed as being low quality wrote a higher mean number of Facts statements on the Follow-up instrument than either Explanation statements or Implications statements. Additionally, although it did not pass statistical significance tests, those who gave high quality ratings to their Websites had a higher mean number of Implications statements.

In the conceptual model depicted in Figure 2, cognitive authority is one aspect of quality. It is a combination of credibility, trustworthiness, and action. The action in the present research was indicated by information utilization as described by the knowledge structures extant at the Follow-up stage. Higher quality assessments of Web resources led to deeper use as the formation of Implications statements indicated. The clear links between Website quality and the type of relational statements written by the participants in the FSC provides experimental verification of the theoretical concept of cognitive authority (Rieh, 2005; Wilson, 1983).

As Rieh notes in her 2002 study, information quality and cognitive authority are related but not equivalent. The version of the WQET used in the FSC included a direct question that asked the participants to rate the credibility of the Website that they were rating. The credibility ratings and the quality ratings were statistically and significantly correlated with each other. Yet, a difference in credibility ratings did not relate to a difference in information utilization as there was no correlation between credibility and the final relational statement types written by the participants. Credibility by itself is not sufficient to determine utilization in these studies. Information utilization is based on the wide spectrum of characteristics that make up the overall quality of the Web resource chosen.

6.5 Limitations

The number of participants in both studies limits the generalizability of the results. Even though numbers were similar to or exceeded the number of participants usually included in user studies, since the sample draws on volunteers, results cannot be extended to include an entire population. The changes in protocol, the differences in sample size and demographics, and the variability in the settings contribute to a decreased internal validity for each study and a corresponding difficulty in comparing and analyzing the results from the two studies with each other and with studies from other researchers.

These limitations can also be viewed in a positive light, as all of the factors listed increased the external validity due to their strong relationship to real world conditions. Since the aim was to study everyday life information seekers the increased external validity gives the research a stronger base upon which to build implications and future research, the topics of the next two sections.

The study protocols relied on self-report of source selection and explicated statements about internal knowledge. Other methods, like natural observation, eye tracking and screen capture may be more reliable for tracking the sources selected, but it would not indicate what the participant utilized. Understanding information utilization can only be done by reviewing explicated statements. An alternative method to that used in these studies might be to review recorded verbal statements.

6.6 Implications

6.6.1 Revised Conceptual Model

Everyday life science and health information seekers that participated in these two studies exhibited different information utilization behavior from information seekers affiliated with a University. Educational level did have some effect. In the second study, the day-to-day experience with food was important in choosing Websites to view. Overall quality was not an important factor in information utilization. These results can be summed up in the revised conceptual model depicted in Figure 6.1. The capital letters in the boxes indicate significant effects of that characteristic while the dashed line is meant to convey a weak tie between quality evaluation and knowledge structure building.

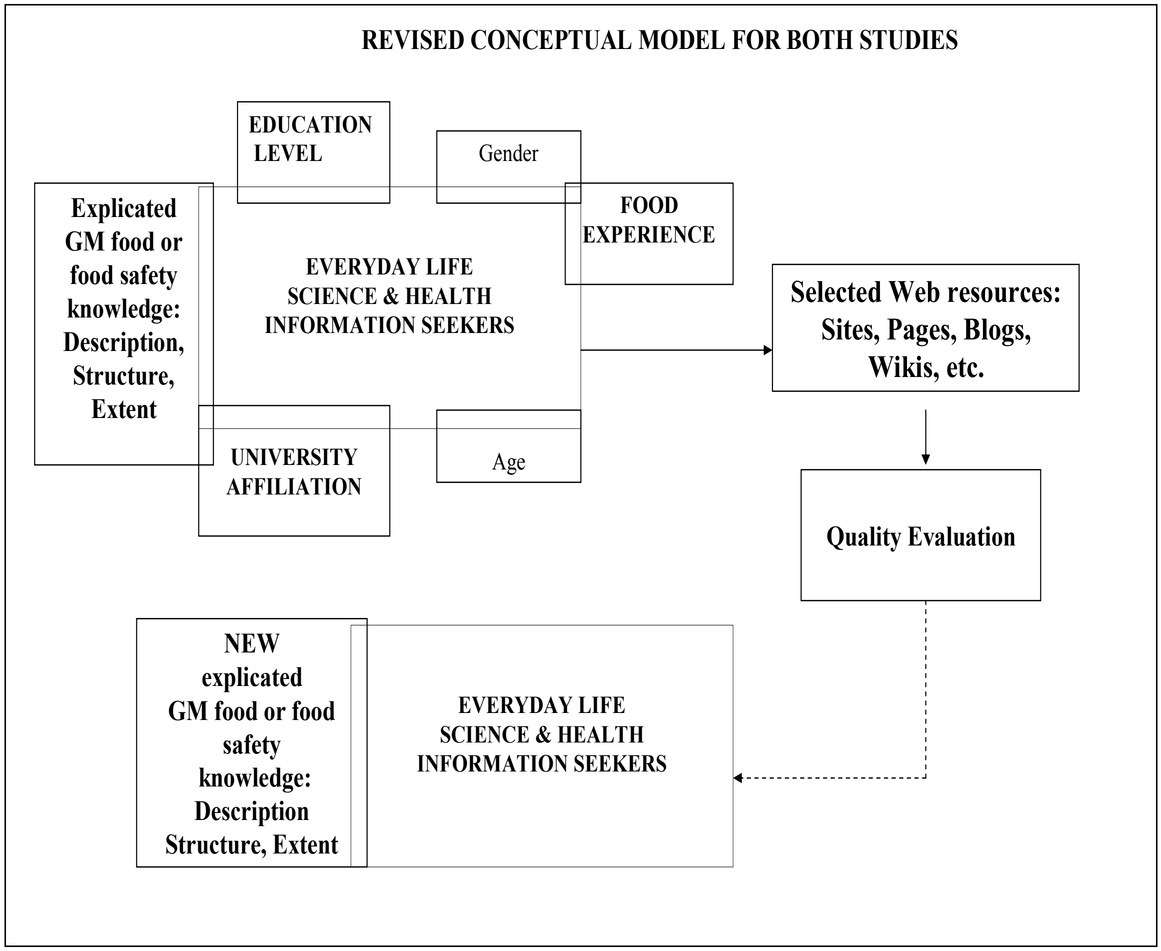


Figure 6. Revised Conceptual Model.

6.6.2 Implications for Research

The results of the two studies indicate clearly that there is great value in seeking participants outside the academy for information seeking and utilization studies (Hargitai & Hinnant, 2006). Differences in information utilization, as revealed in production of relational statements in the GMFC, did not depend on age or educational level, and therefore must be linked to some other characteristic of connection to the University. The educational level differences found in the FSC point back to education as a key factor, but more research is needed. It can be concluded, however, that research based solely on university affiliates may not yield results that are generalizable to a large population though other demographics like age and gender are controlled. There is much to be learned about information seeking and utilization outside the Academy and Information Science researchers should be encouraged to seek the participation of everyday life information seekers.

The repeated measures design used in both studies was useful for understanding how everyday people utilized Web information objects. The drawbacks listed in the limitations could be better controlled in future research to yield stronger results. The value of pre-test post-test investigational methods for Information Science was demonstrated in the results reported in this dissertation.

The research findings clearly indicate that the Web has flattened the traditional hierarchy of science information communication (Wilson, 1977; Ziman, 1968, 1978, 2000). The naïve conceptualizations of the Web objects that were chosen in the GMFC show that everyday information seekers do not distinguish between levels of information available. The confusion over the naming of the Websites in the FSC may also be related to this issue. The observations of choice in these two studies may impact the relatively recent study of document genres and how they relate to information retrieval (Kwasnik & Crowston, 2005). Certainly, more research is called for on the topic of how everyday searchers view the Web objects that they retrieve.

Relational statement analysis is a productive method for understanding knowledge structures and information utilization. The method goes beyond topical content changes and identifies areas where people are confident about the knowledge that they have built. Yet, the method may also be useful in showing the extent of content knowledge as the analysis of Implications statements in the FSC study revealed. Certainly, the Todd (2006) relational statement analysis framework can be recommended for use in studies seeking to reconcile the differences between large, phone survey results and the kind of research done by public understanding of science researchers. Relational statement analysis might be applied to phone survey responses on open-ended questions providing a clearer picture of how the information possessed by the respondent is structured. Knowledge structure data based on relational statement analysis may expand some of the non-responses and some of the participant responses that start with "I don't know", as results in the GMFC study indicated.

Cognitive authority (Rieh, 2005; Wilson, 1983), encompassing as it does credibility, trustworthiness, and action, is a robust theory that could be applied in the broad, emerging area of research termed informal learning. Rather than look only at credibility, a topic of interest in many fields, Information Science could productively examine the utilization of information source formats that are as disparate as a novel, a Website, a movie, and a museum exhibit. Cognitive authority provides the theoretical format for studying why one source might be more effective for information utilization than another.

The studies reported here looked beyond the typical information behavior studies that look at information searching and retrieval. They looked at information after it is viewed, read, and analyzed. Therefore, a more comprehensive view of the effects of cognitive authority can emerge from studies using similar methods. Information utilization studies in many venues should be encouraged.

6.6.3 Implications for Practice

The results reported in this dissertation indicate that quality of sources can be discerned by everyday information seekers, and those perceptions affect the structure of the knowledge that they build. Website quality has profound implications for librarians, teachers, and science information Website designers. Each of these audiences will be considered in this section.

Library practitioners should be concerned because cognitive authority is an important characteristic to note for collection building and reference provision. Whether librarians can decide cognitive authority for others is an unanswered question that Patrick Wilson, himself, poses in his work (1983). Especially in reference situations librarians should be mindful of choosing Websites that have the potential for cognitive authority for an information seeker. Credibility is only one facet that should be considered. Information quality, as measured by the many characteristics included in the WQET, is also important. The WQET is an important starting point for choosing quality Websites.

Science teachers who build their own lists of useful Web resources would be advised to use the WQET, as well. In addition, the concept of cognitive authority is a useful one in education. It may be an important component of both media literacy (see for recent applications Hobbes, 2007) and information literacy (recent works include Radford, Barnes, & Barr, 2005 and Taylor, 2007). It should be considered when designing curricula that address these two important literacies.

Website designers dealing with science content can also be informed by the results in this dissertation. Well-done graphics was shown to be effective in helping participants build new knowledge structures. Good content is not the only consideration for effective communication of science topics; how content is presented is also critical.

6.7 Future Research Directions

The research and practice implications described above lead to several interesting and productive areas for future studies. One such area would be the use of relational statement analysis (based on Todd, 2006) to review open-ended statements made in answer to questions posed in telephone surveys on topics in health and medicine. In the past, many such questions were subjected to content analysis, a productive and useful analytical method (Krippendorf, 2004; Neuendorf, 2002). The addition of the analysis of relational statements may reveal interesting differences in the underlying knowledge structures of the participants in those studies, and therefore to information source utilization. The one-time nature of telephone surveys may limit the use of relational statement analysis since it is best used to compare initial knowledge with that formed after a treatment of some kind.

The Website searching sessions used in the two studies reported here could be replicated with other topics, for instance, the emerging application of nanotechnology, a topic that, at present, like genetically modified foods did in 2004, involves a technology poorly understood by the public. The protocols could easily be adjusted to fit the topic setting.

In a recent review of credibility research, Rieh and Danielson (2007) called for further research on the choices of Websites by information professionals. Given topics similar to those used as context in these studies, the question of what Websites librarians would choose to recommend to their patrons and which ones would they collect for future use, are two possible avenues for inquiry.

As suggested above, relational statement analysis combined with a repeated measures method might be beneficially applied in studying many informal learning[5] situations where science is the focus. Many organizations could adapt the protocols used in these studies to look at information utilization from novels, museum exhibits, large format film, or television shows.

---

[5] Cross (2007) is a recent work using this term in a business setting. A related term in science education is free-choice learning (Falk, 2001).

APPENDICES

Appendix A. Glossary

Key terms that are used throughout this document are defined here.

Cognitive authority

Coined by Patrick Wilson (1983) this term is used to describe the situation where a person allows another person, or the knowledge object produced by that person (a text, a Website, or a videotape), to influence his/her behavior. The awarding of cognitive authority is based on a judgment of credibility and trustworthiness for that information, its source, and its author or a mixture of these three characteristics.

Concept

A definitional label applied to things, people, events or ideas (Todd, 1996).

Conceptual change

In contrast to learning theories that hold that knowledge is simply additive, conceptual change postulates that there is a fundamental shift in the structure of ideas and concepts during knowledge acquisition. This theory is based on empirical studies and theory by Carey (1991), Chinn and Brewer (1993), Thagard (1992), and Vosniadou (1992).

Everyday life information seeking

Savolainen defines everyday life information seeking (ELIS) as “the acquisition of various informational products (both cognitive and expressive) elements that people employ to orient themselves in daily life or to solve problems not directly connected with the performance of occupational tasks” (1995, p. 266-267). It is used in this dissertation to highlight the fact that many, though not all, of the participants are from outside the university and other formal educational settings.

Information

Information is a collection of facts, conclusions, ideas, and creative works of the human intellect and imagination in a form that is both comprehensible and capable of communication (Prythech, 2005; Reitz, 2004). In this study, the collection is recorded in physical artifacts that are available to be used by the public. It is *information-as-thing* (Buckland, 1991, p. 3). The particular artifacts are those available on the openly accessible Web. (See also Source and Treatment).

Information quality

Broadly, information quality involves confidence that the content in an information system meets some specific, agreed upon, standards and provides value to a specified user. It is a subjective measure that varies among users and uses of the content along many dimensions, including context, mode of representation, accessibility, and as an intrinsic characteristic (Wang & Strong, 1996). The information quality of published sources was once controlled by a series of gatekeepers including peer reviewers, publishers, and librarians. The move to more open and easy publishing on the Web led to many disciplines attempting to determine quality criteria. Information quality will be used here to indicate a broad combination of physical characteristic issues, such as functionality, and content issues, such as cognitive authority.

Information utilization

As defined by Todd (1996), information utilization is what people do with information that they encounter. The activity can be an action or behavior, such as choosing to use a consumer product, or be entirely cognitive, as in a change in thought about that product. In this study, information utilization is the cognitive activity that can be analyzed and evaluated by the examination of writing about the topics in the studies.

Knowledge

Knowledge is information that has been understood and evaluated within an individual's experience and incorporated into his/her understanding of the subject (Reitz, 2004). Unlike information, knowledge is associated with a particular human being. It is the sum of his/her ideas, attitudes, experiences, and beliefs. Cognitive knowledge about a topic can be assessed and in this dissertation the focus is on declarative knowledge, or what the study participants can represent of what they know. It will be operationalized as the collection of relational statements that the participants are able to express in writing about particular topics at a given moment in time. (See public knowledge for knowledge that is not related to a particular person.)

Knowledge structures

Internal knowledge is thought to be structured and cohesive. There are many models of the cognitive structure of a person's knowledge, but this dissertation takes a semantic network view that knowledge consists of a series of nodes and linkages. It is asserted that people can demonstrate the structure of their knowledge by the relational statements that they can write about a particular topic (Quillian, 1968).

Public knowledge

In the simplest terms, public knowledge is the set of ideas that is available to everyone (Princeton University Cognitive Science Laboratory, 2007). Brookes (1980a, 1980b, 1980c) describes any knowledge that has been objectified, or made external, as being public. In the present work, the phrase will be used as a description of the results of scientific and other inquiry that has been verified through repetition, accepted by a community of peers, and made accessible to a wide audience (Wilson, 1983; Ziman, 1968). (See also knowledge for the view of personal knowledge taken in this dissertation.)

Relevance

Defined as the extent to which information retrieved in a search of a library collection or other resource is judged by the user to be applicable to the subject of their query (Reitz, 2004). Relevance is not an object of study in this dissertation; however, it is implied that participants choose relevant Websites to review and utilize in building knowledge structures.

Source

A source is any document or other object that provides information sought by a user (Reitz, 2004). A source provides information in a package with specific characteristics. These studies focus on sources available on the open Web. A Web source has a particular authorship, a URL, and certain content. These sources are accessible to any user with a browser and a computer connected to the Internet. The Websites and other artifacts that the participants choose are accessed without subscription or special sign-in procedures.

Treatment

What happens between the first measure of the dependent variable and the last measure in a repeated measures design. In this dissertation, the treatment is chosen and described by the participants.

Appendix B. Study 1: Recruiting Information for Study 1 (GMFC)

VOLUNTEERS NEEDED !!

Would you consider helping us?

Community participants are needed at Rutgers University for a study about food, agriculture and the environment. This study will include searching for information on Websites.

Must be available on campus for 1.5 hours and to respond to a follow up online questionnaire.

Participants will be paid $25.

Please contact (nbird@scils.rutgers.edu) by Date to learn about available sessions and to register. **Please use FOOD RESEARCH in the subject line**.

nbird@scils.rutgers.edu

nbird@scils.rutgers.edu

nbird@scils.rutgers.edu

nbird@scils.rutgers.edu

nbird@scils.rutgers.edu

Appendix C. Study 1 (GMFC): Consent Form to Participate in a Research Study

Consumer Use of Web Information Resources to Learn about Food, Agriculture, and the Environment

A study is being conducted by who is a student in the Library and Information Science Department and a group of community volunteers. The purpose of this research is to understand what people learn from reading websites about genetically modified food and is funded by the United States Department of Agriculture through the Rutgers University, Food Policy Institute.

Forty people between the ages of 18 and 70 years old will participate in the study for approximately two hours (10 pilot study participants; 30 full study participants). The study procedures include completion of a questionnaire before and after the reading of several websites about the topic of genetically modified (GM) food.

- A brief introduction will be given and consent forms will be distributed (5 minutes).
- Participants will then be asked to complete a simple test of their knowledge about genetically modified food. This will take about 10 minutes.
- Then they will be asked to search for information about GM food which will take approximately 10 minutes.
- Evaluation of websites using a quality score sheet (15 minutes)
- A short de-briefing will take place and incentive money given to each participant and receipts signed (10 minutes).
- A short follow-up web survey will be sent to participants by e-mail 2 weeks after doing the experiment and should take less than 30 minutes to complete.

If you agree to take part in the study, you will be assigned a random code number that will be used on each test and the questionnaire. Your name will appear only on a list of subjects. Data collection is confidential and results will only be reported anonymously. Your name will never be listed with the data in any report.

There are virtually no risks to participation in this study. You will receive $25.00 for completing the entire study.

Participation in this study is voluntary. You may choose not to participate, and you may withdraw at any time during the study procedures. In addition, you may choose not to answer any questions with which you are not comfortable.

If you have any questions about the study procedures, you may contact Nora Bird at 609-610-6230. If you have any questions about your rights as a research subject, you may contact the Sponsored Programs Administrator at Rutgers University at (732) 932-0150 ext. 2104. You will be given a copy of this consent form for your records.

Sign below if you agree to participate in this research study:
Participant ____ Date____________________

Principal Investigator ___________________________________Date ___________________

I agree to allow my keystrokes to be logged through logging software:

Participant ____ Date ___________________

Appendix D. Study 1 (GMFC): 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

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 E. Study 1 (GMFC): Web Search Questions

Instructions: Here are some of the questions that we asked you before. Use the questions to search the world wide web with your favorite search engine. When you find a site that you think helps answer the question bookmark it.

Don't worry about the exact answers or finishing all of them. **This sheet will not be collected.**

Questions to help you search:

Tomatoes genetically modified with genes from catfish would probably taste fishy?

By eating a genetically modified fruit, a person's genes could also become modified?

Genetically modified foods are created using radiation to create genetic mutations?

As far as you know are there any foods containing genetically modified ingredients in supermarkets now?

Appendix F. Study 1 (GMFC): 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.

Web Site 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. ____

Appendix G. Study 1 (GMFC): Follow-up Questionnaire about Food, Agriculture, and the Environment A Rutgers University Study

Remember, all answers are confidential. Please enter the participant code you were assigned during the experiment. Your code number can also be found in the email sent to you regarding this follow-up questionnaire.

Participant Code #

Please answer the following questions.

1. What was the best website that you remember from doing the web experiment.

Name of website

URL (if possible)

2. What top two factors made this site memorable.

(a) Please select first factor

Note: In HTML the following will be a drop-down menu and participants will choose one.

Content, Functionality, Authority, Currency and Stability, Links, Graphics, Style, Other

(b) Please select second factor

Note: In HTML the following will be a drop-down menu and participants will choose one.

Content, Functionality, Authority, Currency and Stability, Links, Graphics, Style, Other

3. What information did you learn from this site?

4. What do you know about genetically modified food that you didn't know before participating in this project?

5. How much of this knowledge did you gain from visiting and reading the websites? Please choose one.

- all of what I learned
- most of what I learned
- a moderate amount of what I learned
- a small amount of what I learned
- none of what I learned

6.
a. Did you search for information about GM food during the last two weeks?

- Yes
- No

b. If you selected Yes in 6a, please specify source of information. Check all that apply.

- Website from research session
- Other websites
- Magazines
- Newspapers

c. What other source of information did you use to learn about GM food?

d. What motivated you to do an additional search?

For questions 7 to 9, please choose one option that matches your situation.

7. I think it is safe for me to eat genetically modified food.

- Strongly agree
- Agree
- Somewhat agree
- Not sure
- Somewhat disagree
- Disagree
- Strongly disagree
- No opinion

8. Genetically modified food threatens the natural order of things.

- Strongly agree
- Agree
- Somewhat agree
- Not sure
- Somewhat disagree
- Disagree

- Strongly disagree
- No opinion

9. Should genetically modified foods be labeled?

- Strongly agree
- Agree
- Somewhat agree
- Not sure
- Somewhat disagree
- Disagree
- Strongly disagree
- No opinion

10. Is there anything else that you would like to tell us?

Appendix H. Study 2 (FSC): Consent Form to Participate in a Research Study Consent Form to Participate in a Research Study

Consumer Use of Web Information Resources to Learn about Food and Safety

A study is being conducted by **Claire McInerney, PhD**, who is a professor in the Library and Information Science Department and a group of community volunteers. The purpose of this research is to understand what people learn from reading websites about food safety and is funded by the United States Department of Agriculture through the Rutgers University, Food Policy Institute.

Forty people between the ages of 18 and 90 years old will participate in the study for approximately two hours (10 pilot study participants; 30 full study participants). The study procedures include completion of a questionnaire before and after the reading of several websites about the topic of food safety.

- A brief introduction will be given and consent forms will be distributed (5 minutes).
- Participants will then be asked to explain what they know about food safety. (10 minutes).
- Then they will be asked to search the Web for information about food safety. (30 minutes.)
- Evaluation of websites using a quality score sheet (20 minutes)
- Post-search questionnaire. (10 minutes)
- A short de-briefing will take place and incentive money given to each participant and receipts signed (5 minutes).
- A short follow-up web survey will be sent to participants by email 2 weeks after doing the experiment. (Less than 30 minutes).

If you agree to take part in the study, you will be assigned a random code number that will be used on each test and the questionnaire. Your name will appear only on a list of subjects. Data collection is confidential and results will only be reported anonymously. Your name will never be listed with the data in any report. A copy of the research results can be requested from Dr. McInerney (4 Huntington St., New Brunswick, NJ 08901, Tel: at 732-932-7500 ext. 8218, Email: clairemc@scils.rutgers.edu).

There are virtually no risks to participation in this study. You will receive $25.00 for participating in the study. The results of the study will aid the design and implementation of systems for communicating food risks to the public.

Participation in this study is voluntary. You may choose not to participate, and you may withdraw at any time during the study procedures. In addition, you may choose not to answer any questions with which you are not comfortable.

If you have any questions about the study procedures, you may contact Dr. McInerney (4 Huntington St., New Brunswick, NJ 08901, Tel: at 732-932-7500 ext. 8218, Email: clairemc@scils.rutgers.edu). If you have any questions about your rights as a research subject, you may contact the Sponsored Programs Administrator (Rutgers University Institutional Review Board for the Protection of Human Subjects, Office of Research and Sponsored Programs, 3 Rutgers Plaza, New Brunswick, NJ 08901-8559, Tel: (732) 932-0150 ext. 2104, Email: humansubjects@orsp.rutgers.edu). You will be given a copy of this consent form for your records.
Sign below if you agree to participate in this research study:

Participant ____ Date___________________

Principal Investigator__________________________________ Date___________________

Appendix I. Study 2 (FSC): Food Safety Web User Pre-Search Questionnaire

1. What is your age group? (Please check one.)

    ____a. 18-21

    ____b. 22-30

    ____c. 31-40

    ____d. 41-50

    ____e. over 50

2. What is your gender? (Please check one.)

    _______F _______M

3. What is the last year of school that you completed? (Please check one.)

    ____a. High school

    ____b. Some college or 2 year degree

    ____c. Four year college degree

    ____d. Post graduate

    ____e. Prefer not to respond

4. Do you have training or a degree in: (Please check only one.)

    ____a. Food science

    ____b. Food preparation

    ____c. Biology

    ____d. Nutrition

    ____e. Other related area (please ___________________)

5. What is your occupation? (Please check one.)

    ____a. farmer

    ____b. educator

    ____c. librarian

    ____d. student

    ____e. business

    ____f. government worker

    ____g. other ____

6. How often do you use the Web to search for information (not email, chat, or downloading)? (Please check one.)

____a. everyday

____b. once a week

____c. once a month

____d. once a year

____e. never

7. What search engine(s) do you use? (Please check one.)

____a. Yahoo

____b. Google

____c. MSN

____d. ASK

____e. Other____

____f. Don't know because I am not sure what a search engine is.

____g. Don't know the name but I know what a search engine is and use one.

8. When you find a "good" Web resource, how do you keep track of it?

____a. Bookmark it.

____b. Add it to a file.

____c. Print a copy of a page.

____d. Don't usually keep track of the Web sites that I use.

____e. Other ____

9. Think of a time when you used the Web to look for information. What did you do? Write down as many steps as you remember.__________________________

____

____

____

____

____

10. How often do you look for science, health or food safety information on the Web? (Please circle one)

____a. Frequently

____b. Sometimes

____c. Never

11. Websites are produced by a variety of sponsors, e.g., companies, the US government, educational institutions. Think about a time that you searched for science and health information. If you found conflicting information or different reports of the same story from a **.com**, a **.org**, a **.edu**, and a **.gov** site, which of the these would you be most inclined to believe?

____a. the **.edu** site (a site sponsored by an educational institution)

____b. the **.gov** site (a site sponsored by a government agency)

____c. the **.org** site (a site sponsored by an organization)

____d. the **.com** site (a site sponsored by a commercial enterprise)

____e. I don't search for science and health information on the Web.

12. If any of the following recommended a Website to you which one would you trust the most? (Please check one.)

____a. A news article or TV story

____b. A friend

____c. A librarian

____d. A doctor

____e. A family member

13. Describe what you know about food safety issues.____

____

____

____

____

____

14. On average, how many times a week do you prepare, or help to prepare, you main meal of the day? (Please check one.)

____a. Never

____b. Rarely

____c. Sometimes

____d. Frequently

____e. Always

____f. Prefer not to answer

15. Can you think of a particular organization(s) where you could seek out more information (not a search engine like Google.)

____

16. Describe your overall anxiety level about eating contaminated food by circling the correct number below with 1 being the lowest and 7 the highest

1 2 3 4 5 6 7

Low High

17. We are going to ask you to search on topics related to intentional and unintentional food contamination, keeping food safe, food problems or any of the topics discussed in this survey. Write down some terms that you can think of that you might use to search for information.

____a. ____

____b. ____

____c. ____

Thank you – now we will proceed to the experiment.

Appendix J. Study 2 (FSC): Food Safety Web Search Scenarios

Web Search Scenarios

Think about the following scenarios as you look for information on the Web.
Scenario 1

There was a recent product recall of pre-packaged salads by a major manufacturer. If you had bought this product, find out how this would affect you and your family

Steps to take:
1.Write words or phrases that you would type into Google:

____
____
____
____

2. As you find information remember to Bookmark (or Add to Favorites) all of the Websites that you visit.

3. Briefly summarize the information that you found here.

____
____
____
____
____

Scenario 2

Listeria is often a contaminant that is found in pre-packaged meats such as hot dogs. You are afraid that you may have been exposed to this at a recent picnic. What are the symptoms of exposure? What should you do to notify the authorities?

Steps to take:
1.Write words or phrases that you would type into Google:

____
____
____
____

2. As you find information remember to Bookmark (or Add to Favorites) all of the Websites that you visit.

3. Briefly summarize the information that you found here.

Scenario 3

In late December, 1996 a terrorist revealed that chlordane (a pesticide) had been used to contaminate liquid animal fats produced at a Wisconsin plant. This fat was used to feed dairy cattle and the milk from these farms was sent to cheese, butter, and ice cream manufacturing plants. Some people believe that this kind of thing might be done by other terrorist enemies of the United States.

Steps to take:
1.Write words or phrases that you would type into Google:

2. As you find information remember to Bookmark (or Add to Favorites) all of the Websites that you visit.

3. Briefly summarize the information that you found here.

Appendix K. Study 2 (FSC): Website Quality Evaluation Tool

Your code____________________________

Website URL	
Website Title	
Sponsor	

1-2	3-4	5-6	7	NA
Poor	**Average**	**Good**	**Excellent**	**Not able to assess**

A. PRESENTATION OF INFORMATION

a. Functionality

1. Site loading time.
   1 2 3 4 5 6 7 NA Score _____

2. Navigation.
   1 2 3 4 5 6 7 NA Score _____

b. Graphics

3. Graphics enhance the information and understanding of the site material.
   1 2 3 4 5 6 7 NA Score _____
4. Print choice is readable.
   1 2 3 4 5 6 7 NA Score _____

c. Style

5. Appropriateness of style for the content.
   1 2 3 4 5 6 7 NA Score _____
6. Level of creativity.
   1 2 3 4 5 6 7 NA Score _____

SUBTOTAL FOR SECTION A:PRESENTATION ________

B. CONTENT

a. Content

7. Sources for research findings are given.
   1 2 3 4 5 6 7 NA Score _____
8. Evidence for accuracy
   1 2 3 4 5 6 7 NA Score _____
9. Language appropriate for subject matter.
   1 2 3 4 5 6 7 NA Score _____

1-2	3-4	5-6	7	NA
Poor	**Average**	**Good**	**Excellent**	**Not able to assess**

b. Coverage

10. Information seems current

___ yes (+1) ___no (-1) ___not sure (0)

Score_____

11. Purpose of site is clear.

___ yes (+1) ___no (-1) ___not sure (0)

Score_____

c. Authority

12. Can you easily identify contact information (postal address, phone, and e-mail)

___ yes (+1) ___no (-1) ___not sure (0)

Score_____

13. Information reflects site objective.

1 2 3 4 5 6 7 NA Score _____

14. Rate the credibility of this site.

1 2 3 4 5 6 7 NA Score ______

SUBTOTAL FOR SECTION B: CONTENT ________

SCORING : Copy the subtotal scores from above.

Section A: **Presentation**	Score
Subtotal	
SectionB: **Content**	
Subtotal	
TOTAL	

C. OVERALL RATING

15. What overall rating would you give to this site? (Circle one.)

1 2 3 4 5 6 7

16. Would you trust the information on this site during an emergency? (Please check one.)

_____a. Yes

_____b. No

_____c. Don't know

17. Is there another factor that you think indicates a "quality" web site?

____

____

____

____

Appendix L. Study 2 (FSC): Food Safety Web Users' Post-Search Questionnaire

1. What do you wish that you had done differently?

Answer the following questions from what you learned from the websites that you looked at.

2. What would you tell a neighbor about how to look for information about a food recall?

3. What would you tell a friend about listeria to warn him/her about the dangers?

4. What did you learn about terrorism and food?

Appendix M. Study 2(FSC): Food Safety Web User Follow-Up Invitation

Dear Participant,

About two weeks ago, you consented to take part in an experiment at Rutgers University that involved searching the web for information about food safety. To complete the experiment, you agreed to do a follow-up questionnaire. The purpose of this final questionnaire is to find out what participants learned about food safety from information available on the web. As such, we would greatly appreciate if you would take a few minutes to complete the online survey which can be found by clicking on the following link (URL) below:

Xxxxxfood user study

We would like to reassure you that all responses are confidential and will not be linked to your identity in any way. Please use the same participant code as given to you during the experiment. Your Participant Code is XX. If you have any questions about accessing this online survey or any problems using it please email Nora Bird, nbird@scils.rutgers.edu or myself. Once again, we would like to thank you for your participation and we hope to get your response soon.

Thank you,

Claire R. McInerney, Ph.D.
claremc@scils.rutgers.edu
Principal Investigator

Appendix N. Study 2 (FSC): Follow-up Survey after 2 weeks after Searching

The following is a Web-based survey. Participants are invited to answer the questionnaire with an emailed invitation (See Appendix G).

Introduction:

Welcome to the final piece of the Consumer Use of Web to Learn about Food and Safety study conducted by Rutgers University. Please answer the following ten questions to the best of your ability. Your participant code is the only link to your answer; be assured that your answers will remain confidential.

If you have any questions about the study procedures, you may contact Dr. McInerney (4 Huntington St., New Brunswick, NJ 08901, Tel: at 732-932-7500 ext. 8218, Email: clairemc@scils.rutgers.edu). If you have any questions about your rights as a research subject, you may contact the Sponsored Programs Administrator (Rutgers University Institutional Review Board for the Protection of Human Subjects, Office of Research and Sponsored Programs, 3 Rutgers Plaza, New Brunswick, NJ 08901-8559, Tel: (732) 932-0150 ext. 2104, E-mail: humansubjects@orsp.rutgers.edu).

1. Describe what you know about food safety issues.

   ____
   ____
   ____
   ____

2. How would you use the Web in the case of a future food emergency?____
   ____
   ____

3. Did you search for more information about food during the last two weeks?
   _____a. No
   _____b. Yes
   _____c. Not sure

4. Can you think of a particular organization(s) where you could seek out more information (not a search engine like Google.)
   ____

5. What would you tell a neighbor about how to look for information about a food recall?
   ____
   ____
   ____
   ____
   ____

6. What would you tell a friend about listeria to warn him/her about the dangers?
____
____
____
____
____
____
____

7. What did you learn about terrorism and food?
____
____
____
____
____
____
____

8. Did or will your food buying behavior change in response to what you read?
   _____a. Yes
   _____b. No
   _____c. Don't know

   Why or why not____
____
____

9. Did or will your food preparation habits change in response to what you read?
   _____a. Yes
   _____b. No
   _____c. Don't know

   Why or why not?____
____
____

10. Describe your overall anxiety level about eating contaminate food by circling the correct number below with 1 being the lowest and 7 the highest.

1	2	3	4	5	6	7
Low						High

Thank you

Thank you for your participation in this research that will increase our understanding of how Web resources are used by people faced with a food safety question. We appreciate your time and effort.

Appendix O. Code Book for Knowledge Structure Coding

CODE BOOK
Science and Health Web Information Use: An Experimental Investigation into Knowledge Building by Everyday Life Information Seekers
Study 1 and Study 2
April 4, 2007

Coding Scheme 1: Description of Knowledge

A relational statement is one where there are two or more concepts linked together in some way, e.g., "Listeria is an illness." Relational statements are described by placing them in one of three classifications: Group 1 is facts, Group 2 is Explanations, and Group 3 is Implications. Each group is further divided into three types. Each of these will be described below.

Group 1: Facts

Group 1 focuses on providing FACTS. These are likely to be statements of PROPERTIES, EXAMPLES and MANNER, each described below. Included in this category are statements that relate characteristics, traits or qualities, as well as statements that describe processes, styles and actions, and which give illustrative examples.

Properties

Properties can also be termed "is a" statements. Included in this category are statements that relate to characteristics, traits or qualities. These properties are those that people have as opposed to those which people do. Verbs often used in these types of statements may be "to have", "to show", "to appear", "to exhibit".

- Statements that use the phrases such as "tend to", "prone to", or "likely to" are included in this category since these expressions relate a propensity or predisposition, which may be regarded as a condition or property.
- Statements using phrases such as "to suffer (from)", "to come from", "to be born (with)", often convey a characteristic, condition or property in relation to a person's past or present life experience or situation. These statements are also included in this category.
- Statements that use the verbs "to be defined as "or "to mean" have been included in this category. Though these statements may be associated with explanations, they express more the existence of characteristics, traits or qualities than reasons of how and why.

Manner

This category might be thought of as encompassing the statements that relate the way in which something occurs, happens or is carried out. This category includes statements that relate to the manner in which scholarly investigation or research has been carried out. A distinction has been made between the propensity, likelihood or predisposition of activity and the execution of the activity. The former are classified in the Property category while the latter are placed in the Manner category.

- Statements that describe processes, styles and actions are placed in this category.
- Statements expressing who the actors are in relation to a process, style or action, are put in this category.
- Statements that express the duration or rate at which something occurs are included in this category.
- Statements expressing complete actions, often employing the past tense, are included in this category. For example, "China has a long history of family festivals" is classified as a manner statement (relating past actions).

Set Membership

Captures relationships involving class inclusion. When one of presumably a set of examples has been expressed, this statement has been place in this category.

Statements that relate concepts, ideas or examples in a group or grouped together are included in this category. This form of set membership statement suggests the existence of a larger set by using terms of phrases such as e.g., ex., for example, for instance, form of, type, type of, such as or in this case.

Group 2

Statements in this group focus on REASONS and EXPLANATIONS, including the identification of CAUSES and CONSEQUENCES. Included in this category are statements that express how and why, as well as statements that describe results or outcomes.

Reason

Reason refers to what explains the occurrence or nature of an effect. This is distinct from cause, which refers to what is responsible for the effect. Whereas a cause must exist for an effect logically to occur, a reason may have a relationship to the effect that does not assume responsibility.

- Statements that express how and why.
- Statements relating reason often use the verbs to impact, to influence, to affect, to determine, to shape, to factor (into), to contribute, to encourage, and to promote.
- Statements expressing a reason often make use of in order to or for to link an action with an explanation.

Outcome

Similar to causality statements, outcome statements may use verbs such as to result (in), to lead to, and to effect. However, what distinguishes outcome statements from causality statements is an indication that the effect or consequence is terminal in nature.

- Statements that relate to an end result. Statements that indicates something "leading to …" something else.
- Statements relating the findings or results of scholarly research have been placed in this category.

- Statements that relate to an intended goal, plan or course of action have been included in this category, since such expressions have to do with an outcome.

Causality/Consequence

A cause is a person, event or condition responsible for an effect, result or consequence. A cause must be present for the effect logically to occur; this distinguishes it from things such as factors, influences, and contributors, which are not requisite to the occurrence of an effect.

- Statements that express some event causally leading to another, enabling another event to occur, or resulting in some happening or event.
- Statements classified in this category may use terms such as because, cause (as a verb of noun), effect (in verb or noun form), consequence, to lead (to), and to result (in). Other phrases may be as a result of, linked to, spring from or on the basis of.

Group 3

This group focuses on IMPLICATIONS. These are statements that go beyond explaining and the stating of outcomes, consequences, but take these ideas to another level, including the development of conclusion, or expressing opinions or positions. These statements show personal reflection, evaluation.

- Statements that draw out implications
- Statements that are personal reflections, establishing conclusions and positions

Metacognitive Statements

These statements are descriptions of the type of knowledge possessed by the writer of the statements. These include deficiency statements like “Nothing” or “I am not aware of it” and summative statements like “Exactly how they are made.”

Coding Scheme 2: Accuracy

Descriptions of accuracy were applied on a per statement level using the following codes.

Code	**Description**
1	Accurate statement
2	Inaccurate statement
9	Metacognitive statement, belief, or opinion

Coding Scheme 3: Level of Knowledge

Level of knowledge was determined by examining the entire statements of the partipants.

Code	Description
1	Low knowledge level
2	Some knowledge
3	Quite a bit of knowledge
9	Metacognitive statements, beliefs, opinions

REFERENCES

Agosto, D. E. (2002). Bounded rationality and satisficing in young people's Web-based decision making. *Journal of the American Society for Information Science and Technology, 53,* 16-27.

Alexander, P. A., Kulikowich, J. M., & Jetton, T. L. (1994). Role of subject-matter knowledge and interest in the processing of linear and nonlinear texts. *Review of Educational Research, 64,* 201-252.

Barnes, S. (2003). *Computer-mediated communication: Human-to-human communication across the Internet*. Boston: Pearson Education, Inc.

Beck, S. (1997). Evaluation criteria: The good, the bad & the ugly, or why it's a good idea to evaluate web sources. Retrieved June 21, 2004 from http://lib.nmsu.edu/instruction/evalcrit.html.

Belkin, N. J. (1980). Anomalous states of knowledge as a basis for information retrieval: Etats anomaux des connaissances comme base du reperage de l'information. *Canadian Journal of Information Science, 5,* 133-143.

Belkin, N. J. (2005). Anomalous state of knowledge. In K.E.Fisher, S. Erdelez, & L. E. F. McKechnie (Eds.), *Theories of information behavior* (pp. 44-48). Medford, New Jersey: Information Today.

Belkin, N. J., Oddy, R. N., & Brooks, H. M. (1982). ASK for information retrieval: Part II. Results of a design study. *Journal of Documentation, 38,* 145-164.

Bird, N., McInerney, C., and Mohr, S. (2007). *Users' assessment of Website quality in science information seeking*. Manuscript submitted for publication.

Bloom, B.S., Krathwohl, D. R., and Masia, B. B. (1956-1964). *Taxonomy of educational objectives: The classification of educational goals.* New York: D. McKay.

Boutin, P. (2006). Web 2.0: The new Internet "boom" does not live up to it's name. Slate.com. Retrieved February 18, 2007 from http://www.slate.com/id/2138951/.

Brewer, N. T. (2003). The relation of internet searching to club drug knowledge and attitudes. *Psychology and Health, 18,* 387-401.

Brewer, W. F., Chinn, C. A., & Samarapungavan, A. (1998). Explanations in scientists and children. *Minds and Machines, 8,* 119-136.

Brookes, B. C. (1980a). The foundations of information science. Part I. Philosophical aspects. *Journal of Information Science, 2,* 125-133.

Brookes, B. C. (1980b). The foundations of information science. Part II. Quantitative aspects: classes of things and the challenge of human individuality. *Journal of Information Science, 2,* 209-221.

Brookes, B. C. (1980c). The foundations of information science. Part III. Quantitative aspects: objective maps and subjective landscapes. *Journal of Information Science, 2,* 269-275.

Buckland, M. (1991). *Information and information systems*. New York: Praeger.

Burbules, N. (2001). Paradoxes of the web: The ethical dimensions of credibility. *Library Trends, 49,* 441-453.

Carey, S. (1991). Knowledge acquisition: Enrichment or conceptual change. In S.Carey & R. Gelman (Eds.), *The epigenesis of mind: Essays on biology and cognition* (pp. 257-291). Hillsdale, NJ: Erlbaum.

Chandler, P. & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction, 8,* 293-332.

Chi, M. T. H. & Koeske, R. D. (1983). Network representation of a child's dinosaur knowledge. *Developmental Psychology, 19,* 29-39.

Chinn, C. A. & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of Educational Research, 63,* 1-49.

Cline, R. J. W. & Haynes, K. M. (2001). Consumer health information seeking on the Internet: the state of the art. *Health Education Research: Theory & Practice, 16,* 671-692.

Cool, C. (2001). The concept of situation in information science. *Annual Review of Information Science and Technology 35,* 5-42.

Cosijn, E. & Ingwersen, P. (2000). Dimensions of relevance. *Information Processing & Management, 36,* 533-550.

Cross, J. (2007). *Informal learning: Rediscovering the natural pathways that inspire innovation and performance.* New York: John Wiley & Sons, Inc.

Dervin, B. (1997). Given a context by any other name: Methodological tools for taming the unruly beast. In P. Vakkari, R. Savolainen, & B. Dervin (Eds.), *Information seeking in context* (pp. 13-38). London: Taylor Graham.

Dervin, B. (1998). Sense-making theory and practice. *Journal of knowledge management, 2,* 36-46.

Dillon, A., McKnight, C., & Richardson, J. (1993). Space - the final chapter or why physical representations are not semantic intentions. In C.McKnight, A. Dillon, & J. Richardson (Eds.), *Hypertext: A psychological perspective* (pp. 169-191). New York: Ellis Horwood.

Dragulanescu, N. G. (2002). Website quality evaluations: Criteria and tools. *International Information & Library Review, 34,* 247-254.

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher, 23,* 5-12.

Dumais, S. T. & Belkin, N. J. (2005). The TREC interactive tracks: Putting the user into search. In E.M.Voorhees & D. K. Harman (Eds.), *TREC: Experiment and Evaluation in Information Retrieval* (pp. 123-152). Cambridge, MA: MIT Press.

Eveland, W. P. Jr. & Dunwoody, S. (2001a). Applying research on the uses and cognitive effects of hypermedia to the study of the world wide web. *Communication Yearbook, 25,* 79-113.

Eveland, W. P. Jr. & Dunwoody, S. (2001b). User control and structural isomorphism or disorientation and cognitive load? *Communication Research, 28,* 48-78.

Eysenbach, G., Powell, J., Kuss, O., & Sa, E.-R. (2002). Empirical studies assessing the quality of health information for consumers on the world wide web: A systematic review. *JAMA, 287,* 2691-2700.

Fallis, D. (2004). On verifying the accuracy of information: Philosophical perspectives. *Library Trends, 52,* 463-487.

Fogg, B. J., Sooho, C., & Danielson, D. (2002). *How do people evaluate a website's credibility? Results from a large study* Yonkers, NY: Consumer Webwatch.

Falk, J. H. (Ed.). (2001). *Free-choice science education: How we learn science outside of school.* New York: Teachers College Press.

Gaskell, G., Einsiedel, E., Priest, S. H., Ten Eyck, T. A., Allum, N., & Torgersen, H. (2001). Troubled Waters: the Atlantic Divide on biotechnology policy. In G.Gaskell, M. W. Bauer, & L. Abraham (Eds.), *Biotechnology 1996-2000: the years of controversy* (pp. 96-115). London: NMSI Trading Ltd, Science Museum.

Hallman, W. K., Adelaja, A. O., Schilling, B. J., & Lang, J. T. (2002). *Public perceptions of genetically modified foods: Americans know not what they eat* New Brunswick, NJ: Food Policy Institute. Rutgers, The State University of New Jersey.

Hallman, W. K., Hebden, W. C., Aquino, H., Cuite, C. L., & Lang, J. T. (2003). *Public perceptions of genetically modified foods: A national study of American knowledge and opinion* New Brunswick, New Jersey: Rutgers, the State University of New Jersey, Food Policy Institute.

Hallman, W. K., Hebden, W. C., Cuite, C. L., & Lang, J. T. (2004). *Americans and gm food: Knowledge, opinion and interest in 2004* (Rep. No. RR-1104-007). New Brunswick, New Jersey: Food Policy Institute, Cook College, Rutgers- The State University of New Jersey.

Hand, B. M., Alvermann, D. E., Gee, J., Guzzetti, B. J., Norris, S. P., Philips, L. M. et al. (2003). Message from the "Island Group": What is literacy in science literacy? *Journal of Research in Science Teaching, 40,* 607-615.

Hargittai, E. & Hinnant, A. (2006). Toward a social framework for information seeking. In A.Spink & C. Cole (Eds.), *New Directions in Human Information Behavior* (pp. 55-70).

Harris, A. D., McGregor, J. C., Perencevich, E. N., Furuno, J. P., Zhu, J., Peterson, D. E. et al. (2005). The use and interpretation of quasi-experimental studies in medical informatics. *Journal of the American Medical Informatics Association, 13,* 16-23.

Health on the Net Foundation (2006). HON Code of Conduct (HONcode) for medical and health Web sites. Health on the Net Foundation from www.hon.ch/HONcode/method.html.

Hobbes, R. (Ed.). (2007). *Reading the media: Media literacy in high school English.* Newark, NJ: International Reading Association.

Hong, T. (2006). The Internet and tobacco cessation: The roles of Internet self-efficacy and search task on the information-seeking process. Journal of Computer-Mediated Communication, 11, article 8 from http://jcmc.indiana.edu/ol11/issue2/hong.html.

Huizingh, E. K. R. E. (2000). The content and design of websites: an empirical study. *Information & Management, 37,* 123-134.

Ingwersen, P. (1992). *Information retrieval interaction*. London: Taylor Graham.

Ingwersen, P. (1996). Cognitive perspectives on information retrieval interaction: Elements of a cognitive IR theory. *Journal of Documentation, 52,* 3-50.

Julien, H. & Duggan, L. J. (2000). A longitudinal analysis of the information needs and uses literature. *Library and Information Science Research, 22,* 291-309.

Kim, H. S. & Kamil, M. L. (2003). Electronic and multimedia documents. In A.P.Sweet & C. E. Snow (Eds.), *Rethinking reading comprehension* (pp. 166-175). New York: Guilford Press.

Krathwohl, D. R. (1998). *Methods of educational & social science research: An integrated approach*. New York: Longman.

Krippendorf, K. (2004). *Content analysis: An introduction to its methodology*. (2nd ed.). Thousand Oaks, CA: Sage.

Kuhlthau, C. C. (2004). *Seeking meaning: A process approach to library and information services*. Westport, CT: Libraries Unlimited.

Kuhlthau, C. C. (2005). Kuhlthau's information search process. In K.E.Fisher, S. Erdelez, & L. E. F. McKechnie (Eds.), *Theories of informaiton behavior* (pp. 230-234). Medford, New Jersey: Information Today.

Kwasnik, B. H. and Crowston, K. (2005). Introduction to the special issue: Genres of digital documents. *Information Technology & People, 18*(2), 76-88.

Lesk, M. (2005). *Understanding digital libraries*. (2nd ed.) Amsterdam: Morgan Kaufmann.

Liu, Z. (2004). Perceptions of credibility of scholarly information on the web. *Information Processing & Management, 40,* 1027-1038.

Locke, S. (2002). The Public Understanding of Science - A Rhetorical Invention. *Science, Technology, & Human Values, 27,* 87-111.

Mayer, R. E. (2003). *Learning and instruction*. Upper Saddle River: Merrill Prentice Hall.

McInerney, C. (2000). Establishing and maintaining trust in online systems. Paper presented at the Online 2000 Conference. Retrieved September 30, 2000 from http://scils.rutgers.edu/~clairemc/onlinepaper.htm.

McInerney, C. R. & Bird, N. J. (2005). Assessing Website quality in context: Retrieving information about genetically modified food on the Web. *Information Research*, 10, paper 213. Retrieved August 2, 2005 from http://InformationR.net/ir/10-2/paper213.html.

Metzger, M. J., Flanagin, A. J., Eyal, K., Lemus, D. R., & McCann, R. M. (2003). Credibility for the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. *Communication Yearbook, 27,* 293-335.

Miller, J. D. (1986). Reaching the attentive and interested publics for science. In S.M.Friedman, S. Dunwoody, & C. L. Rogers (Eds.), *Scientists and Journalists: Reporting as News* (pp. 5569). New York: Free Press.

Mizzaro, S. (1997). Relevance: The whole history. *Journal of the American Society for Information Science, 48,* 810-832.

National Science Board (2002). *National science and engineering indicators - 2002*. Arlington, VA: National Science Foundation.

National Science Board (2004). Science and engineering indicators - 2004. National Science Foundation. Retrieved August 17, 2004 from http://www.nsf.gov/sbe/srs/seind04/start.htm.

National Science Board (2006). Science and engineering indicators - 2006. National Science Foundation. Retrieved October 25, 2006 from http://www.nsf.gov/statistics/seind06/.

Neuendorf, K. A. (2002). *The content analysis guidebook.* Thousand Oaks, CA: Sage.

Nielsen NetRatings (2006). Google accounts for nearly half of all web searches, while approximately one third are conducted on Yahoo! and MSN combined. Nielsen//NetRatings. Retrieved April 5, 2006 from www.nielsen-netratings.com.

O'Reilly, T. (2005). What is Web 2.0. O'Reilly.com. Retrieved February 18, 2007 from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html.

Paas, F., Renkl, A., & Sweller, J. (2004). Cognitive load theory: Instructional implications of the interaction between information structures and cognitive architecture. *Instructional Science, 32,* 1-8.

PEW Initiative on Food and Biotechnology (2004a). Factsheet: Genetically modified crops in the United States. internet. Retrieved October 30, 2004a from http://pewagbiotech.org/resources/factsheets/display.php3?FactsheetID=2.

PEW Initiative on Food and Biotechnology (2004b). Overview of findings: 2004 focus groups & poll. internet. Retrieved March 6, 2005b from http://pewagbiotech.org/research/2004update/overview.pdf.

Pew Internet & American Life Project (2007). Demographics of internet users. internet. Retrieved September 25, 2007 from http://www.pewinternet.org/trends/User_Demo_6.15.07.htm.

Prabha, C., Silipigni Connaway, L., Olszewski, L., & Jenkins, L. R. (2007). What is enough? Satisficing information needs. *Journal of Documentation, 63,* 74-89.

Princeton University Cognitive Science Laboratory (2007). Public knowledge. Wordnet: A lexical database for the English language. Retrieved February 12, 2007 from http://wordnet.princeton.edu.

Prythech, R. (2005). *Harrod's librarians' glossary and reference book*. (10th ed.) Aldershot, England: Ashgate.

Quillian, M. R. (1968). Semantic memory. In M. Minsky (Ed.) *Semantic Information Processing* (pp. 227-270). MIT Press: Cambridge, MA.

Radford, M. L., Barnes, S. B., and Barr, L. R. (2005). *Web research: Selecting, evaluating, and citing* (2nd ed.). New York: Allyn and Bacon.

Rapp, D. N., Taylor, H. A., & Crane, G. (2003). The impact of digital libraries on cognitive processes: Psychological issues of hypermedia. *Computers in Human Behavior, 19,* 609-628.

Reitz, J. M. (2004). *Dictionary for library and information science*. Westport, CT: Libraries Unlimited.

Rieh, S. Y. (2000). *Information quality and cognitive authority in the World Wide Web.* doctoral dissertation Rutgers, the State University of New Jersey.

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

Rieh, S. Y. & Danielson, D. R. (2007). Credibility: A multidisciplinary framework. *Annual Review of Information Science and Technology 41,* 307-364.

Roth, W.-M. & Barton, A. C. (2004). *Rethinking scientific literacy*. New York: RoutledgeFalmer.

Saracevic, T. (1996). Relevance reconsidered. In P. Ingwersen & N. O. Pors (Eds.), *Information science: Integration in perspectives. Proceedings of the Second Conference on Conceptions of Library and Information Science (CoLIS 2).* (pp. 201-218). Copenhagen: Royal School of Librarianship.

Saracevic, T. (2006). Relevance: A Review of the Literature and a Framework for Thinking on the Notion in Information Science. Part II. *Advances in Librarianship, 30,* 3-71.

Savolainen, R. (1995). Everyday life information seeking: Approaching information seeking in the context of "Way of Life". *Library and Information Science Research, 17,* 259-294.

Savolainen, R. (1999). Seeking and using information from the Internet: The context of non-work use. In T.D.Wilson & K. Allen (Eds.), *Exploring the contexts of information behaviour* (pp. 356-370). London: Taylor Graham.

Savolainen, R. (2005). Everyday life information seeking. In K.E.Fisher, S. Erdelez, & L. E. F. McKechnie (Eds.), *Theories of informaiton behavior* (pp. 143-148). Medford, New Jersey: Information Today.

Schamber, L. (1994). Relevance and information behavior. *Annual Review of Information Science and Technology 29*, 3-48.

Schamber, L., Eisenberg, M., & Nilan, M. (1990). A re-examination of relevance: Toward a dynamic, situational definition. *Information Processing & Management, 26,* 755-776.

Schutz, A. & Luckmann, T. (1973). *The structures of the life-world*. Evanston, IL: Northwestern University Press.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston: Houghton Mifflin Company.

Shapiro, A. & Niederhauser, D. S. (2004). Learning from hypertext: Research issues and findings. In D.H.Jonassen (Ed.), *Handbook of research on educational communications and technology* (2nd ed., pp. 605-620). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review, 63,* 129-138.

Spink, A. & Cole, C. (2001). Introduction to the special issue: Everyday life information-seeking research. *Library and Information Science Research, 23,* 301-304.

Sullivan, D. (2002). Death of a meta tag. Searchenginewatch. Retrieved September 24, 2005 from http://searchenginewatch.com/sereport/article.php/2165061.

Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science, 32,* 9-31.

Tague-Sutcliffe, J. (1992). The pragmatics of information retrieval experimentation, revisited. *Information Processing & Management, 28,* 467-490.

Taylor, T. (2007). *100% information literacy success.* Australia: Thomson Delmar Learning.

Taylor, R. S. (1985). *Value-added processes in information systems*. Norwood, NJ: Ablex Publishing Corporation.

Thagard, P. (1992). *Conceptual revolutions*. Princeton, N. J.: Princeton University Press.

Tillman, H. N. (2003). Evaluating quality on the net. internet. Retrieved June 21, 2004 from http://www.hopetillman.com/findqual.html.

Todd, R. J. (1996). *Information utilisation: A cognitive analysis of how girls utilise drug information base on Brookes' fundamental equation K[S] + ÄI = K[S+ÄS].* Ph.D. University of Technology, Sydney, Sydney, Australia.

Todd, R. J. (1999a). Back to our beginnings: information utilization,Bertram Brookes and the fundamental equation of information science. *Information Processing & Management, 35,* 870.

Todd, R. J. (1999b). Utilization of heroin information by adolescent girls in Australia: A cognitive analysis. *Journal of the American Society for Information Science, 50,* 10-23.

Todd, R. J. (2005). Information intents. In K.E.Fisher, S. Erdelez, & L. E. F. McKechnie (Eds.), *Theories of information behavior* (pp. 198-203). Medford, New Jersey: Information Today.

Todd, R. J. (2006). From information to knowledge: Charting and measuring changes in students' knowledge of a curriculum topic. Information Research, 11 (4), 264. Retrieved September 1, 2006 from http://InformationR.net/ir/11-4/paper264.html.

Todd, R. J. & Edwards, S. (2004). Adolescents' information seeking and utilization in relation to drugs. In M.K.Chelton & C. Cool (Eds.), *Youth information seeking behavior: Theories, models, and issues* (pp. 353-386). Lanham, Md: The Scarecrow Press.

Tombros, A., Ruthven, I., & Jose, J. M. (2005). How users assess web pages for information seeking. *Journal of the American Society for Information Science &Technology, 56,* 327-344.

Treise, D., Walsh-Childers, K., Weigold, M. F., & Friedman, M. (2003). Cultivating the science internet audience: Impact of brand and domain on source credibility for science information. *Science Communication, 24,* 309-332.

Turns, J. & Wagner, T. S. (2001). Characterizing audience for informational web site design. *Technical Communication, 51,* 68-85.

Vosniadou, S. (1992). Knowledge acquisition and conceptual change. *Applied Pscyology: An International Review, 41,* 347-357.

Vosniadou, S. & Brewer, W. F. (1992). Mental models of the earth: A study of conceptual change in childhood. *Cognitive Psychology, 24,* 535-585.

Wang, R. W. & Strong, D. M. (1996). Beyond accuracy: What data quality means to data consumers. *Journal of Management Information Systems, 12,* 5-34.

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

Watters, C. & Duffy, J. (2005). Motivational factors for interface design. In K.E.Fisher, S. Erdelez, & L. E. F. McKechnie (Eds.), *Theories of informaiton behavior* (pp. 242-246). Medford, New Jersey: Information Today.

Wehmeyer, L. B. (1997). Evaluating internet research. *Syllabus, 11,* 46-48.

Wilson, P. (1977). Public knowledge, private ignorance: Toward a library and information policy. Westport, CT: Greenwood Press.

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

Winker, M. A., Flanagin, A. J., Chi-Lum, B., White, J., Andrews, K., & Kennett, L. (2002). Guidelines for medical and health information sites on the internet: Principles governing AMA web sites. *JAMA, 283,* 1600-1606.

Wright, P. (1993). To jump or not to jump: Strategy selection while reading electronic texts. In C.McKnight, A. Dillon, & J. Richardson (Eds.), (pp. 137-152). New York: Ellis Horwood.

Wynne, B. (1995). Public understanding of science. In S.Jasanoff, G. E. Markle, J. C. Petersen, & T. Pinch (Eds.), *Handbook of science and technology studies* (pp. 361-388). Thousand Oaks, CA: Sage Publications.

Wynne, B. (1996). Misunderstood misunderstandings: Social identities and public uptake of science. In A.Irwin & B. Wynne (Eds.), *Misunderstanding science? The public reconstruction of science and technology* (pp. 19-46). Cambridge: Cambridge University Press.

Zhang, P. & von Dran, G. M. (2000). Satisfiers and dissatisfiers: A two factor model for website design and evaluation. *Journal of the American Society for Information Science, 51,* 1253-1269.

Ziman, J. M. (1968). *Public knowledge: An essay concerning the social dimension of science*. Cambridge: Cambridge University Press.

Ziman, J. M. (1978). Reliable knowledge: An exploration of the grounds for belief in science. Cambridge: Cambridge University Press.

Ziman, J. (2000). *Real science: What it is, and what it means*. Cambridge: Cambridge University Press.

CURRICULUM VITA

Nora J. Bird
njbird@uncg.edu

EDUCATION & DISTINCTIONS

- PhD in Communication, Information and Library Studies, Rutgers, the State University of New Jersey, January, 2008
- Cook College/New Jersey Agricultural Experiment Station Team Award, 2004
- MS in Library and Information Science, Simmons College, 1984
- BA, Biology, cum laude, Boston University, 1979

RECENT EXPERIENCE

Lecturer, 2007-present	The University of North Carolina at Greensboro
Graduate Assistant, 2002-2007	Rutgers University Food Policy Institute
Project Coordinator, 2004-2005	(CISSL) IMLS grant, "Impact of School Libraries on Learning"

PUBLICATIONS

Steiner, L. & Bird, N. (in press). Journalists' assessment of bioengineered food. Newspaper Research.

Bird, N. J. (2006). Effects of differential text formats on adult conceptualization of science: Evidence from three disciplines. Journal of Educational Multimedia and Hypermedia, 15, 249-260.

McInerney, C.R. & Bird, N.J. (2005). Assessing website quality in context: Retrieving information about genetically modified food on the web. Information Research, 10 (2) paper 213, http://informationr.net/ir/10-2/paper213.html

Bird, N. J. (2005). Memorable websites and their impact on adults' learning about science. CJILS/RCSIB, 29, (3), 374.

McInerney, C., Bird, N., & Nucci, M. (2004). The flow of scientific knowledge from lab to the lay public: the case of biotechnology food. Science Communication, 26, 44-74.

TEACHING

Rutgers University, SCILS, New Brunswick, NJ
Adjunct, 2006
Retrieving and Evaluating Electronic Information (Undergraduate ITI Program)
Reference Sources and Services

Southern Connecticut State University, New Haven, CT
Adjunct, 1993, 1999-2000
Reference Materials and Services – Developed and delivered using Ecollege distance learning software.
Foundations of Librarianship