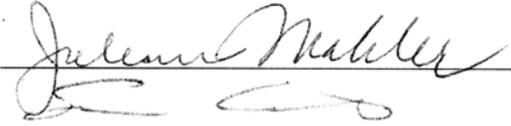
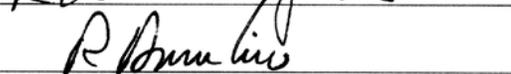


FISHING FOR INFORMATION: EVALUATING CHARACTERISTICS OF WEB
SITES USED TO CONVEY ENVIRONMENTAL RISK INFORMATION THROUGH
FISH ADVISORIES

by

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of
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DEDICATION

This is dedicated to my late father, who taught me to never quit and strive for the highest honor, my mother, who has provided unconditional support, my husband, who is my best friend, and my two children for whom the future is so bright.

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TABLE OF CONTENTS

	Page
LIST OF TABLES	VI
LIST OF FIGURES	VII
ABSTRACT	VIII
CHAPTER 1: INTRODUCTION	1
CHAPTER 2: LITERATURE REVIEW	20
CHAPTER 3: METHODOLOGY	56
CHAPTER 4: SURVEY RESULTS AND ANALYSIS	78
CHAPTER 5: STATE INTERVIEW RESULTS AND ANALYSIS.....	139
CHAPTER 6: CONCLUSIONS	159
APPENDIX 1: RECRUITMENT LETTER TO PARENTS	174
APPENDIX 2: SURVEY QUESTIONS	175
APPENDIX 3: INTERVIEW QUESTIONS POSED TO STATE REPRESENTATIVES	186
APPENDIX 4: SURVEY PILOT TEST REPORT	187
APPENDIX 5: PARTICIPATING NURSERY SCHOOLS WITH TOTAL ENROLLMENT FIGURES AND SURVEY PARTICIPATION	198
REFERENCES	200
CURRICULUM VITAE.....	214

LIST OF TABLES

Table	Page
Table 1. Research Variables and Sampled Population	56
Table 2. Nursery Schools in Montgomery, Prince George's, and Howard Counties.....	61
Table 3. Questions used to Assess Knowledge of Risks of Fish Consumption.....	80
Table 4. Quantifications for Survey Question 17	81
Table 5. Quantifications for Survey Question 18	81
Table 6. Quantifications for Survey Question 19	82
Table 7. Survey Questions Used to Assess Intention to Change Fish Consumption Behavior	84
Table 8. Quantifications for Pre-test Questions Compared with Survey Question 15	85
Table 9. Response Options for Pre-test Question 3 Compared with Survey Question 15	85
Table 10. Quantification for Pre-test Question 4 Compared with Survey Question 16	86
Table 11. Response Options for Pre-test Question 4 Compared with Survey Question 16	87
Table 12. Quantifications for Survey Question 21	88
Table 13. Quantification for Survey Question 22	88
Table 14. Quantification Methodology for Survey Questions 24-28	94
Table 15. Summarized Demographic Characteristics of Sampled Population	97
Table 16. Average Scores for Independent and Dependent Variables	99
Table 17. Overall Behavior Change Score Statistics for Sampled Population	102
Table 18. Response to Survey Question 21	104
Table 19. Response to Survey Question 22	105
Table 20. Knowledge Score Statistics	106
Table 21. Distribution of Ecological Beliefs Score Ratings	108
Table 22. Effects of the Study's Independent Variables on Knowledge Score.....	113
Table 23. Effects of the Study's Independent Variable on Participants.....	118
Table 24. Effects of the Study's Independent Variables on Behavior Change Score	122
Table 25. State Representatives/Participants in State Interviews	142

LIST OF FIGURES

Figure	Page
Figure 1. Mercury Pollution Transport and Cycle	12
Figure 2. Eye Scanning Pattern of Web Users.....	36
Figure 3. Conceptual Framework for Research Study.....	45
Figure 4. Conceptual Framework for Research Study (Reprinted)	129
Figure 5. Graphic of Cross-Section of Fish from Maryland's Advisory Site	152
Figure 6. Mercury Meter Posted on Idaho's Advisory Site.....	153
Figure 7. Conceptual Framework for Research Study Depicting Actual Relationships as Measured	161
Figure 8. Estimated EPA/DHA (grams) and Methylmercury (micrograms) Amounts in One and Two 3-ounce Fish and Seafood Servings per Week Amounts	169

ABSTRACT

FISHING FOR INFORMATION: EVALUATING CHARACTERISTICS OF WEB SITES USED TO CONVEY ENVIRONMENTAL RISK INFORMATION THROUGH FISH ADVISORIES

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George Mason University, 2011

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The American public is increasingly turning to the Internet to gather, analyze, and evaluate information about environmental risks. The goal of most risk-communication campaigns is to help citizens understand and take control of risks, make wise choices, and develop stable and beneficial changes in their risk-related behaviors. All 50 states have issued fish-consumption advisories for certain species of fish that may contain chemicals, such as mercury, polychlorinated biphenyls (PCBs), and dioxins, which can pose risks to human health. These advisories are often made available online with the intent of recommending that people limit or avoid eating certain species of fish caught in specific water bodies. This method of environmental-risk communication is the focus of this study with a special emphasis on an especially vulnerable population, women of childbearing age and parents responsible for the fish consumption of their young children. This study surveys a purposive sample of this target population in the state of

Maryland to determine the respondents' perceptions about characteristics of Web sites used to convey information on safe fish-consumption habits, focusing on the usability and credibility of the information presented. This study also provides insights from discussions with state government officials responsible for issuing such guidelines and publishing sites addressing safe fish-consumption habits.

Using linear multiple regression and logistic regression, analysis of survey responses was conducted to determine the influence of a site's usability and credibility (as well as other factors) on a respondent's knowledge of the risks of fish consumption and their intended behavior changes. Although the results of the analysis do not show that usability and credibility significantly influence one's intended behavior change or their knowledge on this issue, other factors are influential. In this study, a Web site presented in a narrative format (as opposed to a graphical presentation) is a significant predictor of an intended change in behavior. Additionally, younger parents (between the ages of 20 and 39 years) are more likely to report an intended change in their behavior as a result of viewing certain online fish advisories. Another influential factor in intended behavior change includes the respondent's trust in private sources of information. As a respondent's trust in the information generated by a private firm decreases, his or her intentions to change behavior increase. A respondent's fishing habits when mediated by the Web site's presentation format is also a significant predictor. When active anglers view a graphically presented fish-advisory Web site, they tend to report less of an intention to

change his or her behavior in terms of fish consumption, indicating that a narrative site may resonate more with active anglers.

This study shows that one's ecological beliefs and gender are significant predictors of a perfect score of one's knowledge of the risks of fish consumption. The results of this study show that the probability that a respondent will score a perfect knowledge score of the safety of fish consumption increases as one's ecological beliefs score increases. The findings of this study also show that male respondents have a higher probability of scoring a perfect knowledge score, in comparison to female respondents.

An additional finding of the study shows that both state fish-consumption advisory Web sites, California and Maryland, rank low in their usability and credibility. By incorporating a mixed-methodology approach of quantitative and qualitative research, this study highlights potential options for improvement on these Web sites for consideration by state risk communicators.

On a broad scale, this study highlights the importance of the public sector's need to continually evaluate the effectiveness of publically administered Web sites. Making sites easier to use while conveying clear, concise messages and taking steps to appear more credible and trustworthy all help to ensure that online environmental information is communicated, received, and acted upon appropriately by the intended audience.

CHAPTER 1: INTRODUCTION

Effective communication is one key to empowering American consumers to find the risk information they need and to create a feeling of self-control. Given the pervasiveness of the Internet, many consumers are going online to learn about environmental risks, such as the impacts of pesticides, hazardous waste sites, or drinking-water contaminants. At the same time, those responsible for communicating risk information are turning to the Internet to make this information more readily available to the masses. Therefore, it is imperative that the organizations responsible for creating and maintaining these Web sites are considering their sites' effectiveness in terms of their usability, credibility, and overall presentation. Although the Internet is increasingly important in communicating environmental risks, it is important to note that other communication options exist.

Some scholars hypothesize that people learn about health risks, safety risks, and environmental risks indirectly, from talking to others and from other information sources, such as the mass media (Lion, Meertens, & Bot, 2002; Ryan, Dunwoody, & Tankard, 1991). Many studies assess the impact of media types (e.g., magazines, newspapers, and broadcast news) on the public's perceptions of risk (Coalition on the Public Understanding of Science, 2009; McCallum, Hammond, & Covello, 1991; Ryan et al.,

1991; Singer & Endreny, 1993; Trauth, 1994), however, few existing studies assess the impact of Internet-based information on the public's risk perceptions. The intent of this study is to address this gap in the literature.

When one considers how ubiquitous the Internet has become in terms of providing a steady stream of risk information (Bostrom & Lofstedt, 2003; Kasperson & Kasperson, 1996), it is surprising that this gap should exist. Thus, it is relevant to look at how the Internet is affecting consumers' behavior and knowledge. The intellectual merit of this research is to advance our understanding of environmental risk communication and, in particular, to determine the impact of Web-based risk communication on consumers' actions in terms of fish consumption and their fish-consumption choices when feeding their children. To meet these goals, the target population for this study consists of parents (males and females) with young children (aged 6 months to 5 years). The focus of this study is summarized in the research question below.

Research Question. Are a Web site's usability, credibility, and presentation format influential in increasing consumers' knowledge of risks and in affecting their reported intention to change behavior when consuming fish and choosing fish options for their families?

Federal agencies, such as the U.S. Environmental Protection Agency (EPA) and U.S. Food and Drug Administration (FDA), are responsible for creating legislation that

governs environmental contaminants that affect fish populations. However, it is state government organizations that are responsible for setting safe fish-consumption guidelines for their residents, which are communicated as fish advisories. These organizations are also responsible for creating and maintaining Web sites containing these fish-consumption advisories to help ensure that consumers have the information they need to make educated decisions about what they and their families consume.

Fish contamination is so pervasive that all 50 states now have fish-consumption advisories posted on their Web sites (U.S. EPA, 2010a), and increasingly more information is being delivered online by government sources (U.S. EPA, 2009). When state government organizations post information online, it has the potential to reach a large percentage of consumers, especially because, nowadays, Americans look for health information by visiting Web sites, reading blogs, and listening to podcasts. According to the Pew Internet and American Life Project (2009), 61% of American adults go online to look for health information, which represents a new paradigm in acquiring information. However, this also presents a challenge for government organizations and their public administrators required to protect the public's health.

Federal, state, and local governments are required to notify citizens about possible chemical exposures (Goldston, 2008; U.S. EPA, 2011), but, to some degree, how public administrators in these organizations choose to communicate these risks is open for

interpretation. The approaches they select can impact the transparency of the risk (U.S. EPA, 2009; Waldrop, 2008).

The linkages between information acquisition, attitude, behavior change, and consumer choices are complicated. Regardless, public administrators must address processes by which societal learning is made more effective (Kirlin, 1996). Even though state and federal government organizations are communicating more with the public about environmental risks, there has been a long-term decline in public confidence and trust in their messages. Survey data indicate that ratings of confidence in government and industry have severely eroded during the past 30 years (Peters, Covello, & McCallum, 1997). Despite that, an overarching responsibility of the government is to protect citizens by providing accurate, credible, trustworthy information.

In fact, public leaders should be committed to developing, managing, nurturing, changing, and improving the range of information processes, such as those about environmental risks, through which societal learning occurs (Kirlin, 1996). One way of meeting this commitment is through creating a transparent and connected democracy, in this context, through the availability of credible and usable online environmental-risk information. This commitment by public leaders is met using the tools available on the Internet, so that, when consumers are engaged in learning by their own motivations, they have the resources they need to take actions to protect their health and the health of their families. This collective process of self-directed learning by individuals across states and

regions of the county is what enables societal learning about this issue. When this societal learning takes place, public leaders have been effective in communicating. As a result of this aggregate effect, it is important for public leaders to communicate knowledge of choices available, of consequences of alternatives, and of how to achieve desired goals (Kirlin, 1996).

To better understand if these aspects are being communicated effectively to citizens visiting the Internet, this study evaluates the usability, credibility, and presentation format of state-issued Web sites communicating fish advisories and determines whether these factors are influential in increasing consumers' knowledge of risks and in affecting their reported intention to change their behavior when choosing and consuming fish. In this study, the researcher surveys Maryland residents with young children to assess their perception of these factors. The researcher also interviews state representatives from across the country responsible for administering fish-advisory Web sites. These interviews are conducted to determine whether state representatives believe providing a usable and credible Web site impact the way their users perceive the message they are trying to convey.

Observers from across government, academia, and industry are seeing that the Internet is changing environmental-risk communication. The remainder of this chapter addresses (1) the nature and extent of the Internet's impact and (2) the importance of communicating safe fish-consumption guidelines through the Internet.

How the Internet is Changing Environmental Risk Communication

Citizens, and risk assessors alike, are turning to the World Wide Web to gather, analyze, and evaluate information about physical risks (Flanagin & Metzger, 2001). In today's information age, 78% of American adult Internet users use the internet on an average day (Pew Internet and American Life Project, 2010). A study conducted by Flanagin and Metzger (2001) provides empirical confirmation that "the Internet is a multidimensional communication technology used to fulfill well-understood needs in novel ways."

According to a national survey conducted by the Pew Internet Project in December 2008, eight in ten Internet users have looked online for health information. The old industrial-age paradigm, in which health professionals were viewed as the exclusive source of medical knowledge and wisdom, is gradually giving way to a new information-age worldview. Now, patients, family caregivers, and the systems and networks they create are increasingly seen as important healthcare resources (Society for Participatory Medicine, 2008). These individuals, known as e-patients, say the Internet has had a significant impact on the way they care for themselves or for others (Fox, 2010).

Organizations have responded to this trend. Washington University's School of Medicine's (2010) Siteman Cancer Center is striving to help members of the public better understand the factors that increase their risk of "developing five of the most important diseases in the United States" and receive personalized tips for preventing them in the hopes that this knowledge will help individuals stay healthy. Another example is that of

the Environmental Working Group, a non-profit organization that has developed a robust cosmetic safety database that serves as a guide to cosmetics and personal-care products, which are currently unregulated (Environmental Working Group, 2011). This site boasts over 219 million searches since 2004.

Prior to the advent of the Internet, citizens who chose to research, for example, the risk of industrial chemical hazards in their neighborhood, as well as information about how to respond to them, would have gathered information at city hall or public library. The search would likely have resulted in bureaucratic forms and chemical data sheets with little analysis or interpretation of their meaning. Alternatively, they may have retrieved published information that was less accessible (due to the extensive search to find it) and singularly organized. Neither the methodology nor the results would facilitate or encourage the public to gather this kind of information (Griffin, Dunwoody, & Neuwirth, 1997).

The content of information found on the Internet may not be of higher quality, but it is much more accessible to the public today. As a result, it is logical to expect that citizens will become more active in responding to risks and calling for public action. As communications and information technologies continue to advance, they provide unprecedented opportunities (National Research Council, 1997) and accessibility to large quantities of current information. The Internet can provide exposure to graphical risk

representations and virtual experiences that can be effective in changing attitudes and behaviors (Bostrom & Lofstedt, 2003).

“We want to move beyond just posting these communications and actually realize some behavioral change. We want some positive change to come about.” This sentiment was aptly expressed by Thomas Barron, the Standards Section Chief of Pennsylvania’s Department of Environmental Protection (T. Barron, personal communication, December 14, 2010). In today’s climate, scientists and policymakers throughout the public sector are actively posting data, results, interpretations, and warnings about environmental risks on the Web. However, as this study will show, very few know whether these communications are bringing about any change.

Fish Consumption Advisories: The Significance of the Problem

The New York State Department of Health, like all other states in America, issues advisories on eating fish because some supplies contain chemicals at levels that may be harmful to human health. These advisories communicate which fish to avoid and how to reduce one’s exposure to contaminants in the fish one eats. Fish can be nutritious, good to eat, and serve as an important source of protein, while being low in saturated fat. Naturally occurring fish oils lower plasma cholesterol and triglycerides and have been shown to have other health benefits. However, contaminated fish can be the main source of exposure to contaminants, such as mercury. By following the fish advisories, one can

get the health benefits of fish and reduce their exposures to unwanted contaminants (New York State Department of Health, 2010).

Many of these chemicals of concern are a distinct group of chemicals known as persistent, bioaccumulative toxics (PBTs) that threaten human health and the environment. Methylmercury (MeHg), polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane, commonly known as DDT, and dioxin, all considered PBTs, raise challenges for the environment and society because:

- They are persistent. They remain in the environment for long periods of time without breaking down.
- They bioaccumulate. As animals accumulate PBTs in their bodies, these chemicals move up the food chain, increase in concentration, and linger for generations in humans and the ecosystem. Therefore, as humans consume larger fish near the top of the food chain, they may increase their exposure.
- They are toxic. Exposure to PBTs has been linked to a wide range of toxic effects in fish, wildlife, and humans, including effects on the nervous system, reproductive and developmental problems, immune-response suppression, cancer, and endocrine disruption.
- They are mobile. PBTs can travel long distances and generally move easily between air, water, and land, spanning boundaries of programs, geography, and generations (State of Washington Department of Ecology, 2010).

It is for these reasons that the U.S. EPA has established a chemical program to address remaining challenges in addressing priority PBT pollutants, such as mercury, dioxins, and PCBs (U.S. EPA, 2002a).

The public's fear of contaminants in fish and seafood has risen in recent years.

According to The Washington Post (Black, 2009), the percentage of adults aware of and concerned about this problem has increased from 58% in 2003 to 69% in 2008. These fears are not unfounded. Exposure to MeHg can lead to kidney dysfunction and neurological disorders. According to Laks (2009), results from a previous analysis of the National Health and Nutrition Examinations Survey (NHANES)¹ estimated that, as a result of chronic, organic mercury exposure, 300,000 to 600,000 American children were born with elevated risks ($>5.8 \mu \text{CH}_3\text{Hg/L}$ blood) of neuro-developmental disorders during 1999-2000. According to Cave et al. (2010), PCBs, lead, and mercury are present in nearly all U.S. adults. Their analysis of NHANES data from 2003-2004 revealed a possible association between these low-level environmental pollutants and the development of liver disease and suspected nonalcoholic fatty liver disease.

¹ The National Health and Nutrition Examination Survey (NHANES) is a survey research program conducted by the National Center for Health Statistics (NCHS) to assess the health and nutritional status of adults and children in the United States and to track changes over time. The survey, first conducted in 1971, combines interviews and physical examinations. The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests administered by medical personnel. Findings from the survey are used to determine the prevalence of major diseases and risk factors for diseases (Centers for Disease Control and Prevention, 2009).

Additionally, PCBs are classified by the U.S. EPA and the International Agency for Research on Cancer (IARC) as probable carcinogens, mostly on the basis of animal studies (International Agency for Research on Cancer, 1998; U.S. EPA, 1997b).

Human activities, such as coal burning, have produced many tons of ionic mercury, which is readily converted to MeHg by microbes in sediments (Omichinski, 2007). The largest identified source of mercury emissions during the mid-1990s was fossil-fuel combustion by utility boilers, mainly coal combustion. Mercury is emitted as a trace contaminant in the gas exhaust stream when waste materials containing mercury or fuels such as coal, oil, or wood are fired. Two other significant sources of mercury emissions are municipal waste combustors and medical waste incinerators. Of the estimated 158 tons of mercury emitted annually into the atmosphere by anthropogenic sources in the United States, approximately 87% is from these combustion point sources (U.S. EPA, 1997a). Natural sources of mercury emission include volcanic eruptions, weathering of mercury-containing rocks, and forest fires, as shown in Figure 1 below (United Nations Environment Programme, 2004).

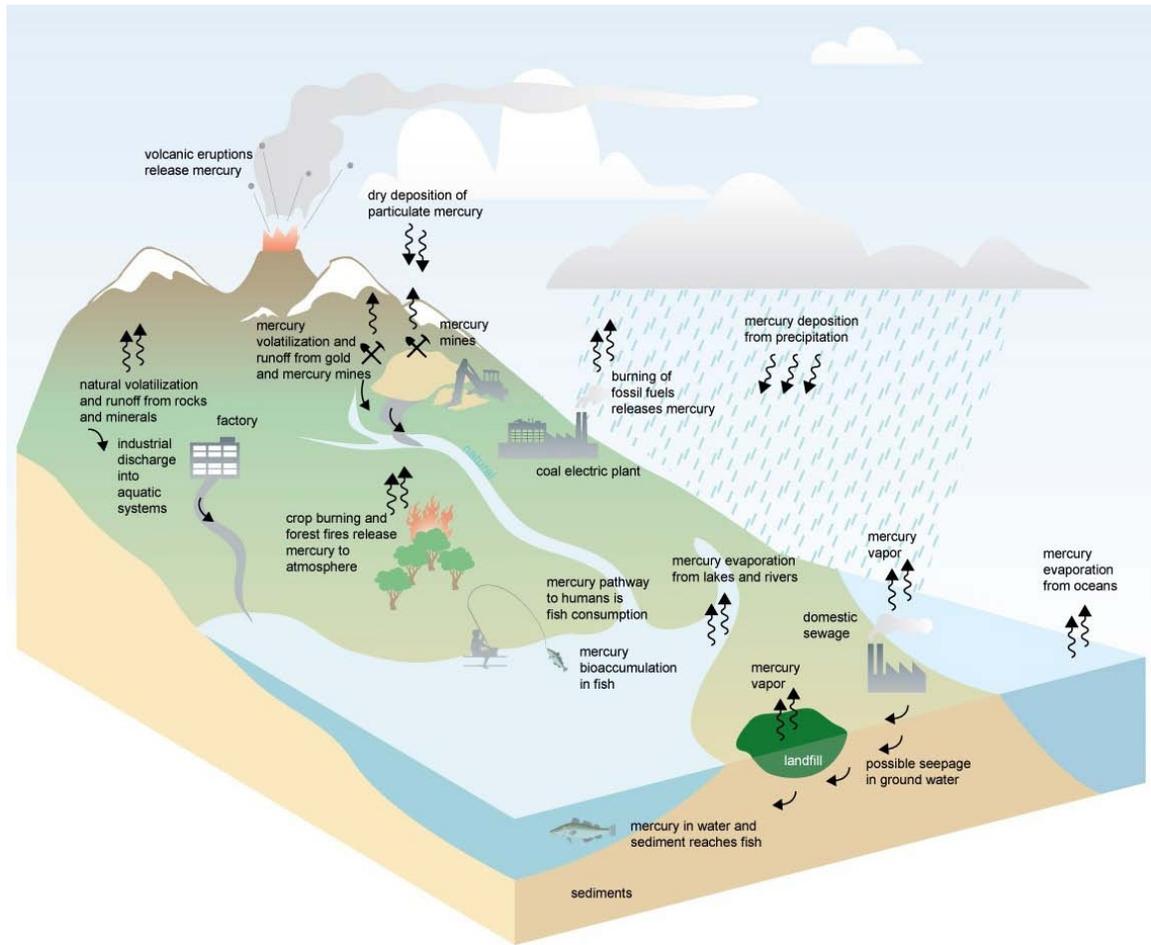


Figure 1. Mercury Pollution Transport and Cycle (United Nations Environment Programme, 2004)

Once airborne, rainfall transfers mercury particles into waterways, where it undergoes a series of chemical transformations that convert the elemental mercury to a highly toxic form that is concentrated in fish and birds (Tewalt, Bragg, & Finkelman, 2001). This conversion to the neurotoxic MeHg form occurs through an anaerobic microbial process. Plankton absorb the MeHg, and, as the smaller fish eat the plankton and the larger predatory fish consume the smaller fish, the MeHg bioaccumulates up the food chain as

these top-order carnivores are consumed by humans. This process results in larger, predatory fish with much higher amounts of MeHg than smaller, nonpredatory fish (Kuntz, Ricco, Hill, & Anderko, 2010).

All fish contain MeHg, regardless of the size or the geographic location of the waters from which the fish is caught, although size and type of fish, as well as the location of the water body, can influence the actual amount of the contaminant (Kuntz et al., 2010). The U.S. Geological Survey (USGS) conducted extensive national and regional studies from 1998-2005 to examine relationships of mercury in water, bed sediment, and fish in streams across the United States (including Alaska and Hawaii). In all, 367 streams were sampled for national and regional studies, with fish mercury concentrations available for 291 streams (Bauch et al., 2009). Mercury contamination was found in every fish sampled in the 291 streams across the country, with approximately one quarter of the fish containing levels of mercury exceeding the U.S. EPA reference dose (RfD)² (Environment News Service, 2009) of 0.1 µg/kg/day (U.S. EPA, 2001, 2010b).

Some of the highest levels of mercury in fish were found in streams in North and South Carolina, Georgia, Florida and Louisiana, which are areas associated with relatively

² A reference dose (RfD) is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a No-Observed-Adverse-Effect-Level (NOAEL), Lowest-Observed-Adverse-Effect-Level (LOAEL), or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. RfDs are generally used in EPA's noncancer health assessments (U.S. EPA, 2010b).

undeveloped forested watersheds containing abundant wetlands, as compared to the rest of the country. High levels of mercury in fish were also found in relatively undeveloped watersheds in the Northeast and the Upper Midwest and in areas of the Western U.S. affected by mining (Environment News Service, 2009). One would expect more mercury in fish in urban streams, but this research indicates this is not the case. For example, in urban streams, mercury is not available to biota because of the relatively high sulfur and sulfate levels, which seems to bind with the available mercury (Lubick, 2009) and may partly explain this inconsistency. As shown by Govindaswamy et al. (1992), mercury has an unprecedented ability to bond with sulfur-containing anions (a negatively charged ion), easily forming a covalent bond. MeHg also has the ability to easily migrate to other metal-binding sites in proteins (Erni & Gerhard, 1979).

Human exposure to mercury occurs primarily through the consumption of fish contaminated through atmospheric mercury releases (Kuntz et al., 2010), whether they are recreationally caught or purchased at a market or store. The fish advisories issued by states apply to consumers of recreationally caught fish; however, some states also post guidelines for commercially available fish. Although some Americans consume fish caught recreationally or for subsistence, most fish consumed in the United States occurs through commercial processes (A. H. Stern, Korn, & Ruppel, 1996; Sunderland, 2007).

As reported by Sunderland (2007), across the entire United States population, most seafood consumed comes from the commercial market. Estuarine and marine fish and

shellfish dominate the edible supply of fish in the commercial market and an estimated 90% of American fish consumption occurs from these commercial sources. This estimate is consistent when contrasted with the portion of the United States population that holds fishing licenses and permits and the nation's imported percentage of fish and seafood. In 2008, 36.3 million Americans had purchased fishing licenses, tags or permits (U.S. FWS, 2008), which represented 12% of the United States population.³ Additionally, the National Oceanic and Atmospheric Administration (2008) estimate that 84% of the nation's fish and seafood were imported in 2007. These measures comprise the estimated range of commercial fish consumption among Americans in this study.

In 2007, canned tuna, which is commonly consumed by Americans, represented approximately 17% of total fish consumption (National Fisheries Institute, 2011).

Consumer Reports tested 42 samples of tuna sold in cans and pouches purchased in the New York metropolitan area and online. Their tests found:

- Every sample contained measurable levels of mercury, ranging from 0.018 to 0.774 parts per million (ppm) (Consumer Reports, 2010). The U.S. FDA can remove products from the market if products meet or exceed their action level of 1 ppm MeHg in the edible portion (U.S. FDA, 2000).

³ This calculation is based on an estimated 300 million United States residents in 2008 (U.S. Census Bureau, 2009). The 36.3 million fishing license holders were divided by the total population, resulting in 12% of population. It is assumed that the remaining 88% of the population obtained fish through commercial sources, if applicable.

- Samples of white tuna had 0.217 to 0.774 ppm of mercury and averaged 0.427 ppm. By eating 2.5 ounces (approximately half a can) of any of the tested samples, a woman of childbearing age would exceed the daily mercury intake recommended by the U.S. EPA.
- Samples of light tuna had 0.018 to 0.176 ppm and averaged 0.071 ppm. At that average, a woman of childbearing age eating 2.5 ounces would get less than the U.S. EPA limit, but, for about half of the tested samples, eating 5 ounces would exceed the limit (Consumer Reports, 2010).

McKelvey et al. (2010), evaluated 19 species or products from retail fish markets in Chinese neighborhoods in New York City in order to supplement existing information on contaminants in commercial fish serving the Asian community. The researchers measured for total mercury and the sum of 101 PCB congeners (related chemicals) in 282 individual specimens. They found that their measured total mercury and PCB levels were comparable to levels that have been reported by the FDA and in other published studies. However, according to the study, a 132-pound female who consumed five 6-ounce servings per week of fish species in the moderate-mercury-concentration range of 0.100 $\mu\text{g/g}$ would be ingesting about twice the RfD (see Footnote 2 for a definition of RfD). Also, several of their tested species had average PCB levels that were substantially higher than those reported in other species in previous studies.

In the McKelvey et al. (2010) study, the highest mercury level (of 1.150 $\mu\text{g/g}$) was measured in a tilefish specimen, and mercury levels in tilefish increased with the specimen size, thus highlighting the bioaccumulative nature of mercury. The highest PCB levels were measured in a buffalo carp (469 ng/g) and a yellow croaker (495 ng/g). Species-specific differences in PCB levels accounted for only 6.3% of total variability, in contrast with 39.2% for mercury.

Susceptible Populations and Benefits

Many studies have shown that low-dose mercury exposure in fetuses, infants, and children is associated with developmental delays, learning disabilities, and possibly behavioral problems (Kuntz et al., 2010). This is why an especially vulnerable population for this type of exposure includes “females who are or may become pregnant or who are breast-feeding and children up to 12 years of age” (Institute of Medicine of the National Academies, 2006).

However, it is important to balance the risks of fish consumption with the proven benefits. According to the American Heart Association (AHA) (2010), fish is an excellent source of 3 polyunsaturated fatty acids, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). The AHA recommends at least two servings of fish per week for healthy adults. There is also the potential for improved cognitive and developmental outcomes for infants and the preventive effects of omega-3 fatty acids on preterm delivery and preeclampsia in pregnant women (Kuntz et al., 2010).

Communicating this contradictory message to individuals, especially those considered to be the most vulnerable, is a difficult task. Efforts to inform the public of MeHg risks and safe eating guidelines have existed since 1993 (Kuntz et al., 2010), but some studies have shown that they have not successfully reached specific vulnerable populations. Anderson et al. (2004) conducted a 12-state survey from 1998 to 1999 of women aged 18 to 45 years. They found that two-thirds of women who consumed sport-caught fish were unaware of state fishing advisories. Most fish advisories are posted on national and state Web sites and distributed through fishing-license brochures (Kuntz et al., 2010), but evaluation of their effectiveness is rarely done.

This study surveys the vulnerable population of women of child-bearing age and young children (whose parents are responsible for the dietary intake of their young children). This group is surveyed about its perspectives of the usability, credibility, and presentation format of fish-advisory Web sites. This study also compares the perspectives of the survey respondents with those responsible for issuing fish advisories. The researcher interviews eight state representatives responsible for administering fish-advisory Web sites to learn about their beliefs of the importance of the usability, credibility and presentation format of their sites.

Broadly, this study assesses how retrieving information posted on the Internet affects the behavior and knowledge of a Web site's users. The purpose of this study is to develop

recommendations to assist government organizations in planning and evaluating environmental-risk information, educational materials, and other risk-communication efforts related to fish contamination delivered through the Web. The conclusions and recommendations stemming from this study will help government agencies and other organizations to improve their risk communication concerning fish-consumption advisories available online.

CHAPTER 2: LITERATURE REVIEW

From fact finding to decision making, the production of knowledge acts as a lifeline for social movements (Jamison, 2006). To attempt to capture this production of knowledge when addressing environmental risks, this review of the scholarly literature addresses (1) the definition and meaning of risk communication, (2) the need for the public sector to communicate well to elicit a change in behavior, most notably through maintaining “useable” and credible information sources on the Web, and (3) the social value of knowledge of risk information. These critical elements of risk communication and its impact on one’s actions will inform this study’s research focus and hypotheses.

The goal of most risk-information campaigns is to help people understand risks, make wise choices, and develop stable and beneficial changes in their risk-related behaviors. Therefore, it is important for scholars and practitioners of risk communication to understand the ways various audiences seek and process the risk information that they encounter in the media and other communication channels (Kahlor, Dunwoody, Griffin, Neuwirth, & Giese, 2003). To achieve this level of understanding, one must first consider the definition and meaning of risk communication.

Definition of Risk Communication

The term *risk communication* is widely used and widely interpreted (for example, one can communicate about financial risk, safety/national security, or food safety). Confusion still remains about what risk communication is, what it takes to communicate risk well, and why more rigorous risk communication efforts are needed (U.S. EPA, 2007). One well-accepted definition of this term is as follows: an interactive process of exchanging risk-related information and opinion among individuals, groups, and institutions (National Research Council, 1989). It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management (National Research Council, 1989). Traditionally, people have thought of risk communication as consisting only of one-way messages from experts to non-experts, or laypeople, which is the focus of this study. Instead, the risk-communication process is now often seen as an interactive process of exchanging information and offering personal or professional commentary in a dialog with individuals, groups, and institutions, as the above definition indicates.

This exchange can affect the success of risk communications. This process is not simply about exchanging and accepting opinions of the communicator. It is about raising the level of understanding among those involved and ensuring that they are satisfied with adequate, credible information, within the limits of available knowledge (National Research Council, 1989). Most attempts to improve risk communication have involved

introducing a single approach intended to meet the needs of all recipients of the message. However, in practice, health and environmental professionals need to be able to tailor the sharing of information to the needs of the individual whenever possible (Edwards, Elwyn, & Gwyn, 1999).

As found in a study conducted by Edwards, Elwyn, & Gwyn (1999) on the exchange of health-risk information between doctors and patients, doctors felt it was important to improve the effectiveness of risk communication. Doctors from South Wales participated in focus groups to evaluate various techniques in communication and found that effective communication of risk could reduce patients' uncertainty and increase their satisfaction with the consultation, especially when these discussions were tailored to the needs of the patient. This leads to a greater understanding of choice, risks, and benefits of different options, a decrease in uncertainty about the choice of treatment, and lower anxiety about the perceived risks of treatment. However, the doctors participating in the study expressed concern about information overload, poorer overall communication between doctor and patient, or heightened anxiety for the patient.

It is important to note that evidence shows accurate, credible information is necessary but is not the only factor required for the effective management of risks. Rowan, Botan, Kreps, Samoilenko, & Farnsworth (2009) outline five fundamental challenges when communicating about physical hazards. These challenges are listed in the mnemonic

CAUSE, referring to issues of confidence, awareness, understanding, satisfaction, and enactment.

The CAUSE Model focuses on five general obstacles to overcome in order to effectively communicate about risk. The first obstacle emphasizes the importance of *creating trust and earning the public's confidence*. The second stresses the importance of *awareness-creation* strategies. The third addresses the *lack of understanding* of the impending danger. The fourth underscores the importance of coming up with *satisfactory solutions to the problem*, and the fifth obstacle points out the need to enact change or *motivate action* (Rowan et al., 2009). Ultimately, all of these elements can be impacted by one's perception of risks, a phenomenon described by research as the social definition of risk.

The Social Definition of Risk

Evidence suggests that people confronted with risky choices do not react purely on the basis of rational cost/benefit calculations (Lion et al., 2002; Slovic, 1987). It is the social definition of risk, rather than the mathematical one, that affects one's choices (Kasperson et al., 1988). These social definitions of risk often come from one of three sources: personal experience, direct contact with other people, and indirect contact (through mass media or other information sources) (Singer & Endreny, 1993). The delivery and substance of risk communications can be greatly impacted by all of these sources.

The way people perceive the nature of a risk—whether it’s voluntary or coerced—can dramatically impact one’s opinion of the risk as well (Kasperson et al., 1988; Slovic, 1987). A classic example of a voluntary risk, as explained by Sandman (2003), involves two types of ski trips. In the first, an individual makes a conscious decision to go skiing. In the second, that same individual is yanked out of bed in the middle of the night, delivered to the top of a mountain with slippery sticks strapped to his feet, and pushed down the mountain.

The experience on the way down the mountain is the same in either scenario, but the first is recreational and the second assault. This analogy holds true for a variety of risks. If the behavior is voluntary, it has been shown to be much more acceptable by the public than if it were coerced (Kasperson et al., 1988; Sandman, 2003).

As addressed above, “the risks that kill people and the risks that upset them are completely different,” says Sandman (2003). There are risks that upset millions of Americans even though they are not killing very many (for example, airplane crashes). This is often because popular media sensationalizes these incidents. On the other hand, there are risks that kill millions of people annually without upsetting very many (for example, car accidents). Experts in the field of risk communication see this unfortunate correlation as a problem of public misperception (Kasperson et al., 1988; Rowan, 2010; Sandman, 2003).

For an individual or group of individuals, risk becomes an issue of “control.” This idea is also reflected in the perceived risks of an airplane crash or a car crash. One has “control” of his or her own car, and, therefore, the perceived risk is marginalized. In an airplane, we surrender control to the pilot and his crew and have to trust that they’ll deliver us safely to our destination, increasing one’s fear. In effect, warning and educating individuals about a potential risk makes it more voluntary and can reduce outrage and perceived or actual helplessness among the public.

It is for this reason that the public sector must increase its focus on communicating effectively to its citizens; doing so reduces citizens’ helplessness by providing them with adequate information. Government organizations need to go beyond basic notifications of chemical exposures and convey the risks these pose to consumers in an effective way.

The Importance of Effective Communication by the Public Sector

The public sector is obligated to educate the public about chemical exposures and the risks these can pose. By educating the public and enabling them to learn about these risks, the information provided by the public sector puts citizens in control to make their own choices. However, it is imperative that these messages are clear.

The way in which one communicates about an environmental risk can truly impact the way an audience interprets and perceives the risk, thus leading to action or inaction, depending on the response. This holds true for the public sector as well as for other large

organizations. The manner by which government agencies communicate risks to the public becomes a significant issue, especially when lives are impacted.

Hurricanes Katrina and Rita in 2005 accounted for an estimated 1,570 deaths of Louisiana residents and approximately \$40 billion in monetary losses (Kates, Colten, Laska, & Leatherman, 2006). Research has shown that many residents reported they were aware of the impending storms and the potential for devastation; however, 15-20% of the residents remained in the regions of Louisiana that were evacuated during the storms (K. Taylor, Priest, Sisco, Banning, & Campbell, 2009). Many of the residents that stayed behind were economically disadvantaged and did not feel that they had the means to leave their homes or neighborhoods (Kates et al., 2006; K. Taylor et al., 2009).

Preparing for evacuation during such an event in areas prone to natural disasters, such as the Gulf coast, may help disadvantaged residents feel empowered in times of crisis. In these types of situations, government organizations ought to consider utilizing the Internet to disseminate pre-developed evacuation plans or to mobilize residents to account for one another immediately before or after an event. Information gained from these Web-based tools can also be disseminated broadly through various social networks, including neighborhood associations and religious-based groups (Kates et al., 2006; K. Taylor et al., 2009). These types of actions by the public sector will help fulfill the fundamental principles of risk communication.

Covello, McCallum, & Pavlova (1987) define three fundamental principles of risk communication. First, citizens in a democracy have the right to participate in decisions that affect their lives, their property, and the things they value. Second, the goal of risk communication in a democracy should be to produce an informed public that is involved, solution oriented, and collaborative—not to diffuse public concern or replace action. Third, risk communication is a two-way activity based on mutual respect, trust, and the open exchange of information. On the basis of these principles, risk-communication efforts by authoritative government agencies aimed at supporting careful decision making can be distinguished from attempts to manipulate public opinion.

Unfortunately, most people don't have the information they need or don't understand the information they get to feel in control of environmental risks in their lives. Essentially, effective public involvement in environmental issues and risks has been hindered by a lack of understandable information being communicated to the public. This is compounded by citizens' limited abilities to evaluate confusing information.

Environmental-risk information can be broad and can include (but is not limited to) information on pesticides, toxic chemicals in drinking water, toxic emissions in air, emergency-response programs, hazardous-waste sites, corrective-action sites, and future site choice of waste-management facilities. Communicating clear, concise, action-oriented risk information is one set of steps that can enable the public to perceive these risks carefully and become more engaged in these discussions (McCallum et al., 1991).

Although government agencies are a major source of information on environmental risks, confidence and trust in government agencies as a credible source of risk information has declined over the last two decades. The following public perceptions have contributed to this decline, according to Covello et al. (1987):

- Regulatory agencies have been overly influenced by industry.
- Agencies are inappropriately biased in favor of promoting particular technologies.
- Agencies are not technically competent.
- Agencies have mismanaged certain health and environmental activities in the past.
- Government agencies are bureaucratic, distant, cold, and uncaring.
- Government officials and experts have lied, presented half-truths, or seriously misrepresented facts in the past.
- Government agencies, officials, and experts often disagree among themselves about important risk issues.

As summarized by Rowan (2010), a study conducted by Priest and colleagues evaluated beliefs about biotechnology, which is a broad category of activities involving human manipulation of foods and pharmaceuticals. Priest and colleagues found variations in the public's trust of institutions such as media, industry, and environmental groups and found that these were stronger predictors of beliefs about biotechnology than a measure of the knowledge of genetics. In general, Priest found that, in the United States, there is a

greater trust in industry than in government and environmental groups related to this issue.

Perceptions of trust in sources of information may also be influenced by community dynamics and cultural biases. For example, previous research on fish-consumption advisories for Southeast Asian immigrants illustrates the importance of considering cultural factors in terms of message effectiveness (Shubat, Raatz, & Olson, 1996). In some cases, tailored fish-consumption advisories have been developed to meet the unique needs of immigrant communities and have been tested to ensure they can be understood by such communities. In fact, research has shown that some of these communities prefer to seek information on the Internet over other means (Fung, 2009). As addressed in Chapter 1, a great number of citizens, not just those from immigrant communities, are looking for information online, as opposed to traditional, more labor-intensive forms of information seeking.

Characteristics of Effective Online Risk Communication

The spread of information systems throughout the economy and social fabric raises questions about the technology's ease of use and quality of information (National Research Council, 1997). This study investigates whether a highly *credible* and *usable* Web site is most effective when communicating environmental risks and whether or not this is influenced by a site's *presentation format*. It is this study's assumption that a site's credibility, usability, and presentation format will influence the user's knowledge

of environmental risks and can spur change in the behavior of the consumer of environmental-risk information. As such, these concepts are explored further below.

Factors that Influence Credibility

A pattern of exaggeration and oversimplification about a risk breeds mistrust, and industry and government are typically known for understating risks (often out of self-interest or ignorance), which undermines their credibility (Covello et al., 1987; Sandman, 2003). It has been shown that state or federal agencies with a track record of being suspect or disliked have a more difficult time convincing the public that their information about a risk is just as “true” as that from other sources (McCallum et al., 1991). Risk managers remain concerned about declining public trust because it erodes the efficiency of risk-management processes (Bostrom & Lofstedt, 2003).

With myriad online resources available, the credibility of Web sites is becoming an increasingly important area to understand (Fogg et al., 2001). The literature on source credibility suggests that characteristics of the source can greatly determine perceptions of credibility (Hong, 2006). Studies, such as that conducted by Hong (2006), show that most seekers of information related to health risks have little or no knowledge of the source of the Web site when initiating their search for information. In any case, in the absence of standing knowledge of the source, there are other factors that can influence this perception of credibility.

“Consider the source...” is a phrase often uttered by pessimists, but it’s an extremely relevant concern when messages about environmental risk are disseminated to the public. The source of environmental-risk communications, regardless of the medium, influences its ability to persuade or influence. It has been shown that credibility, which is often used synonymously with trust, is the most valuable attribute of an environmental information source (McCallum et al., 1991) and a difficult quality to establish.

According to the National Research Council (1989):

Ultimately, lack of credibility alters the communication process by adding distrust and acrimony. The most important factors affecting credibility of the source and its messages are the *accuracy of the messages* and the *legitimacy of the process by which the contents were determined* as perceived by the public. The recipients’ views about the accuracy of a message are impacted by (1) the real or perceived advocacy by the source that is inconsistent or misrepresentative of the facts; (2) a reputation for deceit or coercion on the part of the source; (3) previous statements or positions taken by the source that are inconsistent with the current message; (4) framing the information in a way that is self-serving; (5) contradictory messages from other credible sources; and (6) an actual or perceived incompetence or impropriety on the part of the source.

Similarly, the perceived legitimacy of the process by which the message was developed is influenced by (1) the legal standing of the source with respect to the risks addressed; (2) the justification provided for the communication program; (3) the accessibility or openness of the decision-making process; and (4) the degree to which conflicting claims are given a fair and balanced review.

In a national survey conducted by the Pew Internet and American Life Project in March 2002, about three-quarters of their respondents generally trusted the information they found online when seeking health-related information. However, at some point during their search, they had rejected information from certain Web sites for one reason or another. The top four reasons, as stated by Pew (2002) are:

- Certain Web sites seemed too commercial and seemed more concerned with selling products than providing accurate information.
- They couldn't determine the source of the information.
- They couldn't determine when the information was last updated.
- Sites also seemed “unattractive” when there was no visible “seal of approval,” the design or presentation was sloppy or unprofessional, or “bad” information was present.

The Pew Internet study's findings apply to commercial and government Web sites, and they illustrate key components to consider when disseminating information about

environmental risks. The study results are illuminating because they uncover the breadth of features that can hinder a site's credibility.

Credibility is a product of long-term evidence and commonly shared experience that leads to beliefs that a source is competent, fair, flexible to new demands, and consistent in its task performance and communication efforts. This concept can be substructured into the following components, as proposed by Renn and Levine (1991), which were considered in the methods of this study. The following listed "components" of credibility will form the basis for survey questions that are addressed in the methodology portion of this study in Chapter 3.

- Perceived competence (degree of technical expertise assigned to a message or source)
- Objectivity (lack of biases in information as perceived by others)
- Fairness (acknowledgement and adequate representation of all relevant points of view)
- Consistency (predictability of arguments and behavior based on past experience and previous communication efforts)
- Faith (perception of "good will" in composing information)

Whereas credibility is an important factor, usability is equally important in communicating effectively on the Web and is addressed in the following section.

Factors that Influence Usability

Effectiveness of a site's message is also influenced by its usability. The issue of Web site usability is imperative to consider because the best, most well-written information is diminished if users are unable to find it and use it. Usability, as defined by Nielsen (1994), denotes the ease with which people can interact with a particular Web site or other human-made object or tool in order to achieve a particular goal. Usability also refers to the study of the principles behind an object's perceived efficiency or elegance.

Now that the Internet has become a truly interactive information tool, it is important to devote greater attention to user requirements to ensure that the sites mentioned earlier, and others like them, reach their full potential (U.S. HHS, 2006) in communicating useful information to the public about environmental risks. Through the use of effective design strategies that incorporate users' preferences, site designers can enhance the richness, complexity, resolution, dimensionality, and clarity of the content, thereby extending the users knowledge and experience (Tufte, 1997).

An editorial by *Smashing Magazine* (2008) has captured the current principles, heuristics, and approaches for effective Web design that should be considered when designing or redesigning Web sites. These best practices in usability principles are based on years of experience assessing users' habits. The editors of this publication have found that:

- Users appreciate quality and credibility. If a page provides users with high-quality content, they are willing to accept the distraction of advertisements and inferior site design.
- Users do not tend to read; they scan (as shown in Figure 2). When analyzing a Web page, users search for some fixed points or anchors that would guide them through the content of the page. Note, in Figure 2 below, the red areas clustered near the left margin denote the portion of the Web page that is most frequently viewed by users; the blue areas clustered near the middle, bottom, and right margins denote the areas viewed less frequently. This shows that the eye scanning of users ends abruptly in the middle of sentences.

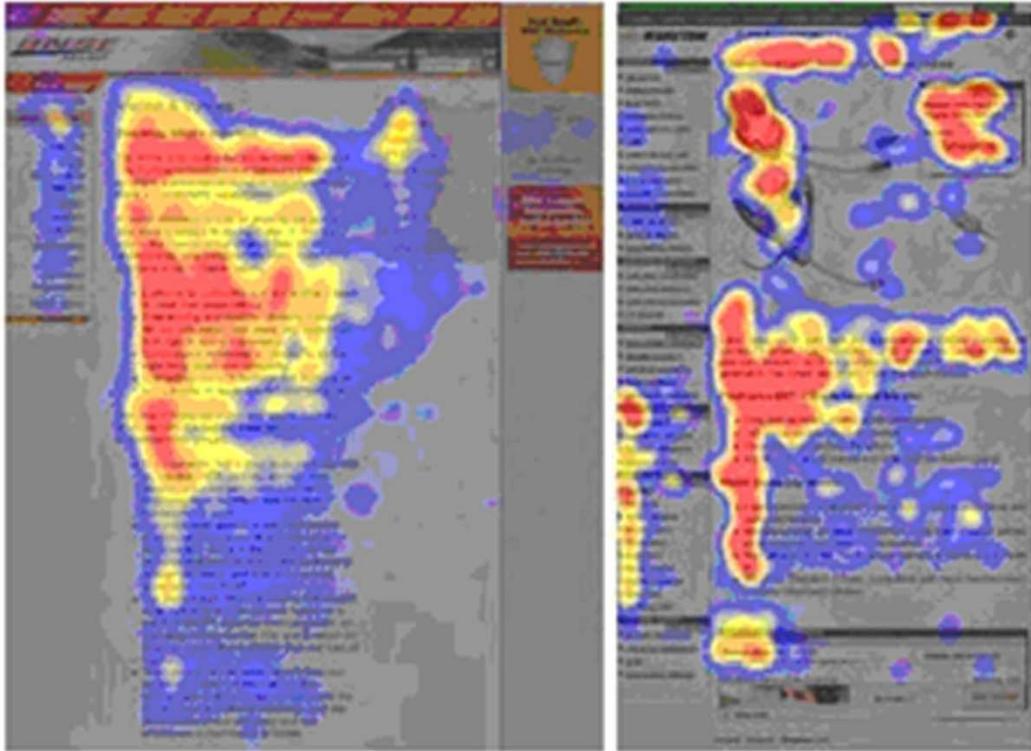


Figure 2. Eye Scanning Pattern of Web Users
(Smashing Magazine, 2008)

- Web users are seeking instant gratification. Web users are quick to search for alternatives when a site requires a higher cognitive load (or the load on one's working memory while surfing a site) and is less intuitive in its navigation.
- Users do not tend to make "optimal" choices. Web users tend to choose the first reasonable option or link if they believe it might lead to their goal. Instead of optimizing their search for information, they strive for efficiency.

When communicating via the Web, it is the usability and the utility, in addition to the visual design, that determine the success or failure of a site. User-centric design has become a standard approach for successful and profit-oriented Web sites because the visitor of a page has complete autonomy and may click (or not click) on whatever they choose. Therefore, if a user cannot use a feature, it might as well not exist (Smashing Magazine, 2008). We have seen that the audience seeks, selects, and processes information on the Web in a nonlinear fashion, which is different from traditional media sources (Yaros, 2009a).

Listed below are the factors of usability heuristics that were considered in the methods of this study on the basis of the studies highlighted above. In addition to visual design/presentation format, these heuristics provide techniques to help ensure that the user interface is efficient, allowing one to locate the desired information as quickly and easily as possible (Nielsen, 1994). Research has shown that users benefit from small chunks of explanatory information and sites that contain elements that are effectively “woven” together (Yaros, 2009a). This effective design approach can be achieved by focusing on the following usability characteristics. It is these “components” of usability that form the basis for survey questions that are addressed in the methodology portion of this study in Chapter 3 (Nielsen, 1994).

- Use of simple and natural dialogue (speak the users’ language)
- Minimize the users’ memory load
- Practice consistency among terminology and navigation

- Offer the user an easy exit
- Provide shortcuts for the frequent users
- Try to prevent errors
- Provide help and documentation

Web Site Presentation Format

To effectively utilize advances in technology, site designers and risk communicators need to better understand the ways in which people learn from words and pictures (Yaros, 2009b). Yaros (2009b) reminds us that potentially powerful animations, for example, are meaningless if the user cannot make sense of the graphic or determine what concepts or elements the animation is trying to support.

There are multiple ways to present information on the Web, but often we find that information is presented visually (through graphical representation), textually (through narrative explanations), or by utilizing a combination of both presentation formats. Studies have shown that presentation techniques such as these can influence behavior, not only through the Web. Lando and Labiner-Wolfe (2007) conducted a study on various food labels and found that the presentation of nutrition information on these labels could cue consumers to make more healthful choices. In some cases, consumers even feel deceived when certain information about nutrition is characterized differently.

In a study conducted by Yaros (2009b) on the Web-based presentation of scientific information, participants spent significantly more time viewing graphical presentations in news stories than those that presented information in a narrative format. He points out that the presence of the graphic resulted in a higher cognitive load among the study participants, therefore highlighting the need for site designers to use graphics judiciously and keep them as simple as possible.

In this study, the researcher selected two Web sites, one with a graphical presentation and another with a narrative presentation. On the basis of the findings by Yaros (2009b), this study assumes that a narrative presentation of information on the Web will reduce the memory load required by users and will, therefore, have a greater influence on its users as compared to the graphical presentation.

These elements of credibility, usability, and Web site presentation format as discussed above, not only influence the quality of a Web site's message, but also can truly shape citizen understanding of an issue. In order to move from understanding to taking action and changing behavior, one must consider the social value of environmental-risk information and what motivates individuals to learn about risks.

The Social Value of Knowledge of Risk Information

In public administration, the fragmentation of policies, programs, and funding flowing from national to state to local governments makes effective action at the "point of

impact” extraordinarily difficult. The capacity to achieve the desired results in complex systems, such as those involving public policy, is challenging. In this case, governments are the creators and shapers of the desired direction; however, it is the central values of the citizens in a democracy that ultimately control the choices that are made and the direct actions taken. An important challenge for public agencies is to improve the whole of societal learning, not through merely a passive understanding, but through actively engaging the public in information acquisition (Kirlin, 1996).

Citizen understanding, or social learning, can ultimately determine the effectiveness of a policy and even influence policies in a democracy. Truly “improving” the learning that can occur in society can result in a more effective understanding by citizens of the importance of a policy and build an appreciation of the choices and complexities that led to it. In the end, this posture can enhance the strategies for action that improve the odds of achieving the desired goals for the public (Kirlin, 1996). It has been argued that this is, not only a desirable goal for policymakers, but also one that should be expected of them (Appleby, 1949). One overarching responsibility of the government is protecting citizens by providing accurate information.

Despite a regulatory framework, risk communication is particularly important in light of the fact that the government is not always directly involved with managing environmental hazards. Whereas some environmental hazards are regulated, protection from many hazards requires action, and in some cases a behavior change, by individuals, such as

dealing with geological radon in their homes (Baker, 1990) or opting to utilize in-home water-filtration systems to ensure healthy drinking water in one's household. As government sources provide information, they can allow for individuals to take such actions.

These actions can come about as a result of a citizen's will to learn. In the context of this study, consumers want to protect their children from the negative effects that contaminants can pose, which motivate them to learn about safe fish contamination. As explained below, critical reflection is a key motivator in seeking greater amounts of information and can influence the process of emancipatory learning about such issues. The importance of self-directed learning by adults is addressed from a theoretical perspective in the next section.

Theoretical Basis for Research Study

In research, theories serve as logical explanations and function largely in three ways: (1) to prevent a false belief in some pattern or archetype, (2) to make sense of observed patterns in a way that can suggest other possibilities, or (3) to shape and direct research efforts, pointing toward likely discoveries through empirical observation (Babbie, 2006). In order to evaluate citizen understanding and social learning about environmental risks, a brief theoretical analysis of concepts on adult learning follows.

For many decades, the question of how adults learn has occupied the attention of scholars and practitioners. There is no one theory or model of adult learning that explains all that we know about adult learners, the various contexts where learning takes place, and the process of learning itself. Instead, there is a combined set of models, a mosaic of theories, sets of principles, and explanations that compose the knowledge base of adult learning (Merriam, 2001). However, one theory, Jack Mezirow's *Theory of Transformative Learning*, has stimulated a great deal of discussion in the field of adult education (E. W. Taylor, 1997).

Mezirow derived the theory of transformative learning in 1978 by interpreting the ideas of Jurgen Habermas' theory of communicative action, which provided the social theoretical context for transformation theory (Mezirow, 1991). Transformation theory represents Mezirow's efforts to develop a comprehensive theory of adult learning (E. W. Taylor, 1997) and, in short, is defined as the process of making meaning of one's experiences (E. W. Taylor, 1998). The concept of transformational learning posits critical reflection by the learner as central to the process of learning (Merriam, 2001) and is further defined as the social process of constructing and appropriating a new or revised interpretation of the meaning of one's experience as a guide to action (E. W. Taylor, 1997).

This concept of critical reflection focuses on the "understanding of the historical, cultural, and biographical reasons for one's needs, wants, and interests...where such self-

knowledge is a prerequisite for autonomy in self-directed learning” (Mezirow, 1985). This cognitive process of self-directed learning promotes emancipatory learning and positions an individual for social and political action (Merriam, 2001). Emancipatory learning is defined as the process of freeing oneself from forces that limit one’s options and control over one’s life. Typically, these forces have been taken for granted or seen as beyond one’s control. This kind of learning is constructivist in nature (meaning one constructs knowledge for oneself) and can be transformative (Cranton, 1994). This theory, along with these concepts, while not the main focus of this study, forms the basis for it.

These processes of self-directed and emancipatory learning are fueled by the access to information through the Internet. Many individuals seek information online because it is less burdensome, and this process of information seeking can make it much easier for consumers to learn about environmental risks that impact their families. Effectively communicating environmental-risk information online ensures public administrators fulfill their responsibility by facilitating adult learning about environmental risks.

Conceptual Framework for Research Study

The rationale for this study is to evaluate the importance of self-directed learning via the Web as a mechanism for obtaining environmental-risk information. This approach allows consumers to take control of risks and make wise choices. The process of learning about a risk helps consumers move beyond a situation of helplessness when faced with an

environmental risk. The focus of the research methodology, as outlined in Chapter 3, is to quantitatively and qualitatively evaluate the components of credibility, usability, and presentation format on state fish-advisory Web sites. Additional factors of one's environmental attitude, as measured by adherence to the New Ecological Paradigm (NEP), and social demographic influences will also be considered in the quantitative portion of the study. These independent variables are shown on the left side of the conceptual framework for this study as developed by the researcher, shown in Figure 3 below. The impact of these independent variables on participants' knowledge and understanding of Web-based fish advisories and their intended change in behavior serve as the dependent variables in this study, as shown on the right side of Figure 3.

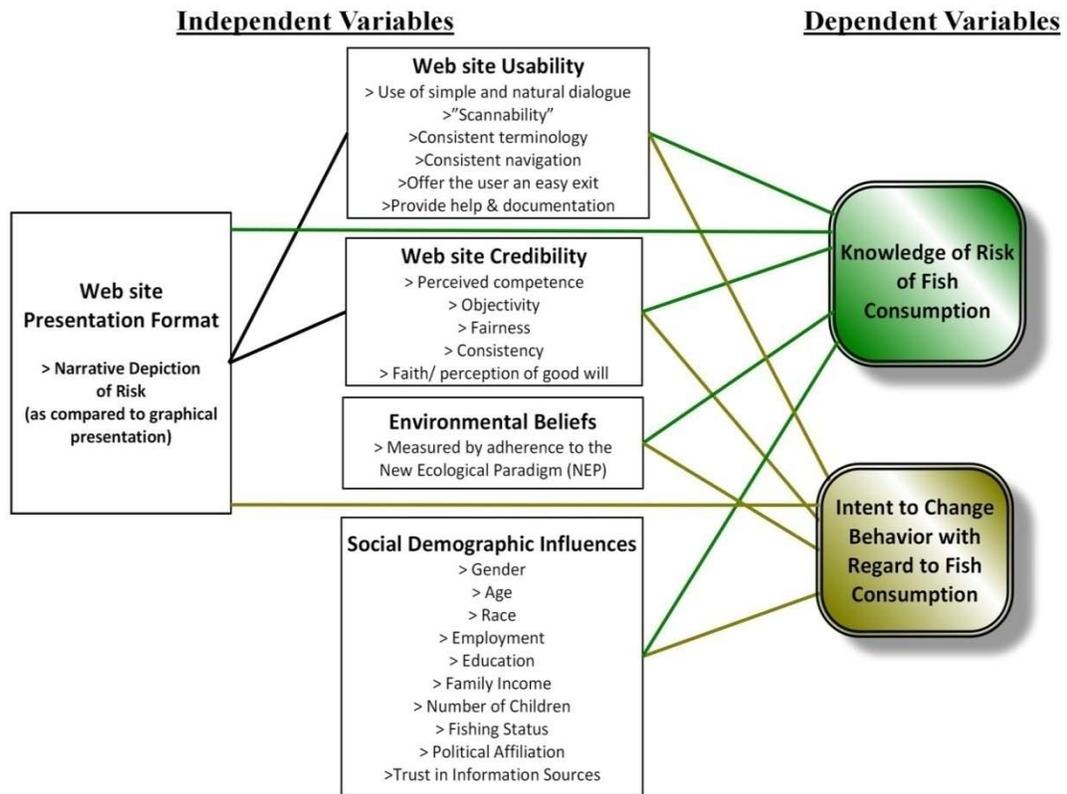


Figure 3. Conceptual Framework for Research Study

The purpose of communicating safe fish-consumption practices is to help consumers understand the risks of fish consumption and adjust their behavior so they consume fish that contain fewer contaminants. As a result, the dependent variables selected for analysis are (1) knowledge of the risks of fish consumption and (2) a reported intention to change behavior with regard to fish consumption. As stated earlier, it is this study's assumption that a site's credibility, usability, and presentation format will influence these dependent variables. It is possible that the presentation format selected by a Web site designer may influence the perceptions of usability or credibility. Therefore, this study

also assesses whether the presentation format of a site impacts its usability or credibility. Because this study addresses environmental risks, one's attitudes toward the environment are also taken into account. Social demographic influences, such as one's gender, age, race, and other characteristics, are considered in this study because these may also influence one's knowledge or intentions to change behavior.

Generally, the researcher expects to see high levels of knowledge among the study's participants on the basis of information gained from state fish-advisory Web sites. Hicks, Pivarnik, & McDermott (2008) conducted an Internet-based survey to determine consumer knowledge, attitudes, and perceptions of seafood and found low knowledge scores among the study's participants. These findings also show that 81% of the participants were not aware of state-issued fish-consumption advisories. Because this study will expose participants to such advisories, it is the researcher's belief that high levels of knowledge will be exhibited among this study's participants.

Additionally, the researcher expects to see an intention to decrease one's consumption of fish among the study's participants on the basis of information gained from state fish-advisory Web sites. This assumption is consistent with a previous survey conducted with pregnant women. Oken et al. (2003) surveyed pregnant women to assess their fish consumption patterns after exposure to a national mercury advisory and found diminished consumption of fish among this population.

The analysis of these variables, as depicted in Figure 3, will contribute to a greater understanding of effective techniques to communicate fish advisories on the Web.

Focus of Research Study

This study focuses on the federal and state response to elevated levels of mercury and other contaminants, such as polychlorinated biphenyls (PCBs) and dioxins, which ultimately pollute waterways and aquatic life. Federal officials depend on effective communication about this risk to help the public understand that reducing their consumption of affected fish populations can help reduce the overall risk to society at a faster rate (U.S. EPA, 2002b). This effective communication is critical as it improves the capacity of public administrators to achieve the desired results of policies that seek to protect human health and our ecosystems. As discussed earlier, government officials and public administrators essentially create and shape public policy but are limited on the direct actions by citizens that are elicited by the policy. It is truly the citizens' values and choices—which can be shaped by these communications—that ultimately control the outcome (Kirlin, 1996). The current state of information on fish contamination may influence one's choices and knowledge, in turn impacting the amount and type of fish one consumes and feeds to their children.

The intention of this study is to determine what characteristics communicators of fish advisories need to consider in order to effectively disseminate information online about the risks of consuming contaminated fish. This study will collect users' preferences to

inform communicators of fish advisories. The purpose is to closely align the content delivered with the way in which people can most effectively process the information and find it most useful.

The Effectiveness of Fish-Consumption Advisories

In this study, the impacts of a Web site's credibility and usability will be assessed to better understand the environmental risk of high concentrations of mercury and other contaminants in the environment. As addressed earlier, this is an issue of concern to society at large and it affects the safety of human consumption of fish and seafood because methylmercury (MeHg) exposure from consuming fish and shellfish is a significant public health concern in the United States (Groth, 2009). It has been shown that mercury is a global pollutant that is ubiquitous in the environment (Laks, 2009; Selin, Sunderland, Knightes, & Mason, 2010). Inorganic mercury, once deposited into ecosystems, may be converted to MeHg (Selin et al., 2010), and chronic exposure to MeHg is associated with elevated risks for autism, mental impairment, and neurodegenerative disease (Laks, 2009). Within the diet, fish and shellfish contain the highest mercury concentrations although trace amounts of total mercury may be detected in other dietary components (such as eggs, organ meats such as kidney, or offal) (Mahaffey, Clickner, & Bodurow, 2004).

MeHg, which can pass through the placenta to the developing fetus, can severely harm the brain and nervous system of developing fetuses and young children. As a result,

pregnant women and young children are especially susceptible to the health effects associated with high concentrations of mercury exposure (World Health Organization, 1990). Research conducted by Hawkins (2009) revealed that mothers, when surveyed, were more likely to report reducing their fish intake due to concerns about mercury, as compared to those without children. Additionally, mothers were also more likely to alter their fish intake because of their awareness of the advisories, though not always in recommended ways. In some instances, fish, which serves as an important source of protein, was being completely eliminated from their diets.

Hawkins (2009) found that communication with the public about fish-consumption advisories concerning mercury was important in order to protect public health. In order to engage citizens and ensure that they understand the benefits and risks of consuming fish, innovative methods of communication are needed that include actively seeking input from the public. More importantly, the methods used to communicate this information, such as state advisories issued online, need to be constantly evaluated and updated in order to be effective.

Communication with the public about fish-consumption advisories concerning mercury and other contaminants is an issue that continues to engage researchers. For example, these issues were among the focus of the 2009 National Forum on Contaminants in Fish, held in Portland, Oregon from November 2-5, 2009. The Forum, which was sponsored by the U.S. EPA and co-hosted by the Oregon Department of Human Services, addressed

the latest challenges and research regarding the awareness and effectiveness of fish-consumption advisories.

Much of the research presented at the Forum was exploratory in nature and illuminated the need to further evaluate the clarity of advisories and methods of delivery. Vardeman and Aldoory (2008) found that, when women were confronted with conflicting information regarding fish consumption, they (1) experienced skepticism of the information and confusion, (2) scrutinized the credibility of the source, and (3) often relied on interpersonal sources, such as trusted peers or opinion leaders, for additional information. Fung (2009) found that, when querying the younger Chinese-Canadian population about advisories on the risks of mercury in fish, they preferred to seek information on the Internet over other means.

As highlighted above, there are many factors that influence a citizen's desire to seek information and motivate the process of self-directed learning when seeking information on fish-contamination advisories. It is important to consider these influences and motivations in order to evaluate the impact these messages are having on social learning.

Motivations to Learn about Contaminants in Fish

Per capita fish consumption in the United States has increased in recent decades (National Oceanic and Atmospheric Administration, 2008). Several factors may be contributing to this increase, such as changing consumer preferences, the proliferation of

sushi restaurants, more widespread availability of fresh seafood in supermarkets, and an increased focus on the health benefits of fish consumption (Groth, 2009). Environmental concerns, namely contaminants bioaccumulating in the food web, have also impacted consumer preferences in terms of fish consumption and have influenced citizens' desire to seek information on fish consumption and its safety. As shown in Chapter 5, state Web sites communicating fish-consumption advisories receive anywhere between a couple hundred to thousands of hits on their sites each month on this issue.

While a great deal of literature exists on the effectiveness of risk-communication practices and principles (Fischhoff, 1995; National Research Council, 1989; Slovic, 1987; U.S. EPA, 1992, 2002b), there is little existing research on the effective utilization of online communications technologies for risk communication. Therefore, this study will seek to (1) evaluate usability and credibility of Web-based state-issued fish advisories and (2) measure the participants' knowledge of the risk of fish consumption and their intent to change their behavior by a target population, namely parents with young children. Given the lack of available research to paint a meaningful picture of risk- information dissemination on the Internet and the apparent thirst of citizens to seek information online, this study is timely in its intent to illuminate the effectiveness of online risk information.

An additional possible influence on the success of self-directed learning regarding environmental risks stems from the way information is "framed" or presented. It has

been shown that different ways of “framing” information can influence the perceptions of risk and the decisions among patients dealing with health risks (Rothman & Salovey, 1997; Wilson, Purdon, & Wallston, 1988). A variety of techniques can be used to convey risks, including relative risk, absolute risk, and the use of descriptive, numerical, or graphical formats to convey the risk (Edwards et al., 1999; Lipkus, 2007). This component of presentation format is especially important because many communicators of state fish-advisory Web sites are making a choice in their design method during the development or redesign of their sites. As revealed in the interviews described in Chapter 5, state risk assessors often opt to present information in either a graphical or narrative format (and in a few cases in both formats) for a variety of reasons. It is these approaches that a user is presented with when visiting these types of sites; therefore, analysis of the presentation format is a critical element of this study. These factors, among others, are considered as independent variables in this study and are addressed in the hypotheses below.

In order to better understand the impact of environmental concern and one’s fundamental views about nature and humans’ relationship to it (Dunlap, Van Liere, Mertig, & Jones, 2000), the target population will also be asked about their environmental beliefs. This will be accomplished by focusing a portion of survey questions on the NEP Scale developed by Dunlap, Van Liere, Mertig, & Jones (2000). The NEP Scale is perhaps the most widely used socio-psychological measure in the literature on environmentalism (P. C. Stern, Dietz, Abel, Guagnano, & Kalof, 1999) because it measures awareness of very

general adverse consequences of environmental conditions (P. C. Stern et al., 1999) . In this study, adherence to the NEP is measured using five items from Dunlap's longer scale of fifteen items as shown in Stern, Dietz, Abel, Guagnano, & Kalof (1999). It is hypothesized in this study that one's attitudes about environmental concerns will positively influence the effectiveness of sites communicating fish-consumption advisories.

The final hypothesis evaluates social demographic influences. The participants' gender, age, race, employment status, education level, family income, number of children, fishing status, political affiliation and trust in information sources will all be considered. These characteristics are considered in this study because these may also influence one's knowledge or intentions to change behavior.

Research Question and Hypotheses

During the 1980s and 1990s, researchers conducted several studies on the effectiveness and importance of communication about environmental risks (Fischhoff, 1995; National Research Council, 1989; Slovic, 1987; U.S. EPA, 1992, 2002b). In many cases, these findings apply to a variety of media, such as print materials (newspaper and magazines) and news broadcasts, but they do not necessarily apply to information delivered over the Web. Using the following research question, this study will strive to fill gaps in the current research literature by assessing which tools and concepts, such as those associated

with usability, credibility, and presentation format, are most effective in communicating about environmental risks through the Internet.

Research Question. Are a Web site's usability, credibility, and presentation format influential in increasing consumers' knowledge of risks and in affecting their reported intention to change behavior when consuming fish and choosing fish options for their families?

Hypotheses

H.1. The perceived usability of a Web site will influence its effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

H.2. The perceived credibility of a Web site will influence its effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

H.3. The narrative-based presentation format will have a greater influence on effectiveness than the graphical format in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

H.4. One's attitude about environmental concerns, as measured by the NEP, will positively influence the effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

H.5. One's social demographic influences will impact the effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

CHAPTER 3: METHODOLOGY

In this study, participants were surveyed on their knowledge, attitudes, and reactions to environmental-risk information available on State government Web sites concerning information on contamination of fish. In order to prove or disprove the five hypotheses outlined in the previous chapter, this study seeks to assess the relationship between five independent variables and two dependent variables as outlined in Table 1. This study assesses whether a Web site's usability, credibility, and presentation

Table 1. Research Variables and Sampled Population

<p>Dependent Variables:</p> <ol style="list-style-type: none">1. Participants' knowledge of risk of fish consumption2. Participants' intent to change behavior with regard to fish consumption <p>Independent Variables (as judged by respondents):</p> <ol style="list-style-type: none">1. Web Site Usability<ul style="list-style-type: none">• Use of simple and natural dialog;• Minimize the user's memory load (i.e., "scannability");• Consistent terminology;• Consistent navigation;• Offer the user an easy exit;• Provide help and documentation.2. Web Site Credibility<ul style="list-style-type: none">• Perceived competence;• Objectivity;• Fairness;• Consistency;• Faith/perception of good will.3. Web Site Presentation Format<ul style="list-style-type: none">• Graphical (State of California Advisory site)• Narrative (State of Maryland Advisory site)4. Environmental Beliefs5. Social Demographic Influences <p>Respondents: Parents (male and female) with young children (ages 6 months to 5 years)</p>
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format and one's environmental beliefs or demographic characteristics can influence one's knowledge of risk of fish consumption or intent to change their behavior with regard to fish consumption.

As outlined in Chapter 2, the elements that comprise usability (shown in Table 1) are generated from Nielsen (1994), an editorial by *Smashing Magazine* (2008), and Yaros (2009a). Research has shown that users benefit from sites that contain elements that are effectively “woven” together and small chunks of explanatory information (Yaros, 2009a). This effective design approach can be achieved by focusing on the following usability characteristics. These adapted “components” of usability form the basis for the survey questions in this study (Nielsen, 1994).

- Use of simple and natural dialogue (speak the users' language)
- Minimize the users' memory load by providing a scannable site
- Practice consistency among terminology
- Practice consistency among navigation
- Offer the user an easy exit
- Provide help and documentation

The components of credibility (also shown in Table 1) are derived from Renn and Levine (1991) and the Pew Internet and American Life Project (2002). As described in Chapter 2, credibility is a product of long-term evidence and commonly shared experience that lead to beliefs that a source is competent, fair, flexible to new demands, and consistent in

its task performance and communication efforts. In this study, the concept of credibility is substructured into the following components, as proposed by Renn and Levine (1991), which form the basis of the survey questions.

- Perceived competence (degree of technical expertise assigned to a message or source)
- Objectivity (lack of biases in information as perceived by others)
- Fairness (acknowledgement and adequate representation of all relevant points of view)
- Consistency (predictability of arguments and behavior based on past experience and previous communication efforts)
- Faith (perception of “good will” in composing information)

In addition to measuring usability and credibility, this study measures respondents’ environmental beliefs. This is measured using the New Ecological Paradigm (NEP) Scale as adapted by Dunlap, Van Liere, Mertig, & Jones (2000). The NEP Scale is perhaps the most widely used socio-psychological measure in the literature on environmentalism (P. C. Stern et al., 1999) because it measures awareness of very general adverse consequences of environmental conditions (P. C. Stern et al., 1999). In this study, adherence to the NEP is measured using five items from Dunlap’s longer scale of fifteen items as shown in Stern, Dietz, Abel, Guagnano, & Kalof (1999).

The researcher seeks to evaluate the usability and credibility of two Web-based state-issued fish advisories, which vary on the basis of their presentation format. The first advisory that is evaluated is issued by the State of Maryland (available at: <http://www.mde.state.md.us/programs/Marylander/CitizensInfoCenterHome/Pages/citizensinfocenter/fishandshellfish/index.aspx>) and is considered narrative in nature because of its text-based content. The second advisory is issued by the State of California (available at: <http://oehha.ca.gov/fish.html>) and is graphical in nature because of its primary map interface depicting water bodies with fish-consumption advisories.

These advisories are evaluated using experimental design, where participants were asked to complete pre-test questions on their fish consumption behavior and post-test questions after viewing one of the two Web sites. The advisories are evaluated through a small-scale social survey with a purposive sample, subjects who represent a specific population to ensure that certain types of individuals displaying desired attributes are included in the study (Berg, 2007). This target population consists of parents (males and females) with young children (aged 6 months to 5 years) that reside in Maryland and, through the survey, are asked about their understanding and reaction to these online communications.

It is important to assess the habits and preferences of this group because the fish-consumption habits of parents affect the dietary intake of their children, as they are the primary caregivers early in life. Young children and women of child-bearing age are especially susceptible to the health effects associated with high concentrations of mercury

because methylmercury (MeHg) can pass through the placenta to the developing fetus and can severely harm the brain and nervous system of developing fetuses and young children (World Health Organization, 1990).

The researcher employs a mixed-methodology approach to strengthen the validity of this study by conducting interviews with eight state representatives responsible for posting their state's fish advisory on the Web. This approach is built into the design of this study to determine whether state communicators believe usability and credibility are influential factors when they design their Web sites. This mixed-methodology approach is being employed in order to strengthen the quality of the results of this research. The use of multiple data-gathering techniques to investigate the same phenomenon will provide a richer data set (Berg, 2007; Druckman, 2005) that delivers a robust view of the issue from the eyes of respondents as well as the communicator. This technique, known as triangulation, allows for the use of multiple lines of sight. By combining several lines of sight, this research will obtain a better, more substantive picture of reality; a richer, more complete array of symbols and theoretical concepts; and a means of verifying many of these elements (Berg, 2007).

Identifying Study Participants

Participants for this study were recruited from three counties in Maryland, considered part of the Washington, D.C. metropolitan area. Recruitment occurred through the participating nursery schools, as listed in Table 2 below. Participants in the study were

asked to take an online survey entitled, “Fishing for Information: A Study on Web Sites Conveying Fish Advisories.”

Table 2. Nursery Schools in Montgomery, Prince George's, and Howard Counties Participating in the Study

Nursery School Name, Location, and Web Site
Bannockburn Nursery School 6314 Bannockburn Drive, Bethesda, Maryland 20817 http://www.bannockburnnurseryschool.com/
Belair Cooperative Nursery School 3120 Belair Drive, Bowie, Maryland 20715 http://www.belaircoop.org/
Bethesda Cooperative Nursery School 5033 Wilson Lane, Bethesda, Maryland 20814 http://www.bethesdacoopnurseryschool.org/
B'nai Israel Nursery School 6301 Montrose Road, Rockville, Maryland 20852 http://www.bnaiisraelcong.org/template.cfm?cid=304&CFID=95184238&CFTOKEN=60298416
East Columbia Preschool 6800 Cradlerock Way, Columbia, Maryland 21045 http://www.eastcolumbiapreschool.com/ECP/Welcome.html
Har Shalom Early Childhood Education Center 11510 Falls Road, Potomac, Maryland 20854 http://www.harshalomecec.org/
Rockville Community Nursery School 100 Welsh Park Drive, Rockville, Maryland 20850 http://www.renscoop.org/
Rockville Presbyterian Cooperative Nursery School [Non-denominational] 215 W. Montgomery Avenue, Rockville, Maryland 20850 http://www.rpcns.org/
Silver Spring Nursery School 10309 New Hampshire Avenue, Silver Spring, Maryland 20903 http://www.silverspringnurseryschool.org/
Stevens Forest Nursery School 6061 Stevens Forest Road, Columbia, Maryland 21045 http://www.stevensforestnurseryschool.org/

Sample Size

In quantitative research, the number of participants in a study needed to answer the research question(s) is derived from a sample-size calculation. Among the design considerations, consecutive or random sampling is frequently used, and bias is minimized by well-defined inclusion and exclusion criteria that avoid measurement errors and misclassification of subjects (George & Apter, 2004).

Rather than following a random sampling approach, a purposive sample was selected for this study, as addressed earlier. In a random fashion, respondents were assigned to view one of two Web sites on the basis of the first letter of their last names. One group of the survey respondents evaluated the Web-based state-issued fish advisory from California; the other group evaluated the advisory from Maryland. These Web sites were chosen as a measure of two presentation formats, which is one of five independent variables in this study. As a result, these two groups were treated as separate treatments only when analyzing the difference of means. Following Cohen's (1992) approach for sample size for a large effect size at the .05 alpha, 26 participants were needed for each of the two groups when conducting a means-difference test (i.e., t-test).

To assess the predictive value of all five of the independent variables in this study, multiple regressions were conducted. Logistic regression was conducted to predict the probability of a respondent achieving a high knowledge score given the known values of the independent variables. Linear multiple regression was conducted to assess the

predictive nature of the respondents' intent to change their behavior on the basis of the independent variables. Again following Cohen's (1992) approach for sample size for a large effect size at the .05 level, 50 participants were needed to conduct an eight variable multiple regression. In this study, responses were collected from 108 respondents that were solicited from the schools listed in Table 2, exceeding the minimum number of participants required for either analysis technique.

Study Limitations: Threats to Reliability and Validity

Surveys can make a strong claim for reliability because of the relatively large number of cases in a typical survey (as compared to qualitative research). However, reliable evidence is an insufficient base on which to make important decisions; the evidence must also be valid. Greater reliability and validity in surveys can be achieved in the design and implementation of the survey. Generally in survey research, these issues of validity focus on whether a sample represents a large enough population (Druckman, 2005).

In this study, there are various threats to the external validity. Ideally, this study would seek responses from parents affiliated with a wide range of nursery schools representing different geographical and socioeconomic characteristics. However, the schools that opted to participate in this study represent consumers of upper socioeconomic status. Additionally, this survey relies on self-selected respondents that have opted to participate in the study, possibly representing some strong inclination for the respondent to make his or her voice heard. An additional threat to the external validity of the study relates to

external environmental events. The survey was conducted in the fall/winter of 2010, approximately 7-8 months after the explosion of BP's Deep Water Horizon oil rig. Extensive national media coverage of this incident and the resulting impacts on Gulf aquatic life and human health impacts were addressed throughout this time. This incident could skew the participants' perception of risk and urgency to retrieve information about the consumption of fish.

An additional threat to the external validity of the survey could arise on the basis of the participants' curiosity to seek information on fish contamination in their community during the time the survey is administered. Because this survey is administered over the Web, the researcher has no control mechanisms to ensure that the respondents do not leave the survey and gain additional knowledge on survey topics because their interest may now be piqued. In order to mitigate this potential threat, it was stated in the survey's introduction that the researcher is interested in the specific characteristics of the Web site associated with the survey. This reminder was also reiterated throughout the survey.

Various concerns on the internal validity of the study also exist. Even though survey respondents were instructed to view one of two fish advisory Web sites, it is not specifically known whether their measures of knowledge or intentions to change behavior are solely attributable to the Web site they viewed. Therefore, the question remains whether the Web site was the causal variable as opposed to some other factor.

Additionally, half of the respondents tested the fish advisory from Maryland. Because

the respondents reside in Maryland, they may have some bias toward the information they viewed. A final potential threat to the internal validity relates to an inherent bias for or against information issued by government sources. Since the respondents reside in the suburbs of Washington, D.C., they may be employed by government agencies or have other associations with government bodies that may skew their perspectives on the quality of the information.

In terms of reliability, it is important to note that the sample size in this study is sufficient to detect an effect among the tested population of parents with young children in the state of Maryland but is not large enough to represent the population as a whole. Additionally, the results will not be generalizable to other environmental risks such as information on pesticides, toxic chemicals in drinking water, air toxic emissions, etc. Similarly, the results will not be generalizable to the portion of the population that may not be familiar with retrieving information over the Web. However, because this survey is targeting information that is disseminated over the Web, non-Web users are not as much of a concern.

The researcher employed an additional measure used to strengthen the validity of this study: conducting interviews with eight state representatives responsible for posting their state's fish advisory on the Web. This process of triangulation will be employed by collecting qualitative data in order to enhance the quantitative data in this study. Survey data allow for a detailed collection of quantitative findings based on the standardized

nature of question and answer options. However, traditional surveying techniques sacrifice the ability to present a detailed view of the topic (Creswell, 1998). This is done by comparing and contrasting perspectives of the survey respondents against the perspectives of the risk communicator as garnered from the interviews.

Interviews with State Risk Communicators

In addition to the survey above, the researcher queried eight state risk assessors/risk communicators who are responsible for (or have a role in) issuing fish advisories from their states. These short, but in-depth, interviews were helpful in determining whether state communicators believe usability and credibility are influential factors when they design their Web sites. These discussions also provided a basis for comparison between the intent of the state-issued information and the needs and preferences of the target population from the survey. These discussions showed that many of the state risk assessors and communicators who were interviewed were extremely concerned with effectiveness of their message and wanted to know more about how their messages were being received by their users.

A total of eight interviews were conducted from November 2010 to January 2011. Representatives from California, Idaho, Louisiana, Maine, Maryland, New Jersey, Pennsylvania, and South Dakota were interviewed. Each interview was conducted by phone and lasted approximately one hour. The findings from these discussions are

addressed in Chapter 5, and the specific questions used during the interviews can be found in Appendix 3.

The state representatives were asked about their role in issuing fish contamination advisories on the Web and whether alternate forms of communication are used by their organizations (such as brochures, posters, etc.). Interviewees were also asked what specific protocols they follow to employ components of usability and credibility on their sites. The specific standards for Web design that were addressed in the questions included their use of (1) simple language, (2) considerations of the site's scannability, consistent terminology, and navigation, and (3) the ability for their users to find their way back to previous information or to ask questions or submit comments and whether they find these questions/comments useful. Additional questions addressed how they provide objective information and represent all relevant points of view. The researcher also asked about the amount of traffic their sites generate as well as the design method and presentation format they chose for their site and the factors that influenced this decision and whether they have considered usability testing of their sites by users.

The remainder of this chapter addresses the approach followed to recruit for and conduct the survey with the target population as well as the survey methodology. The analysis techniques used to assess the data are also introduced below.

Recruiting for and Conducting the Survey

Nursery school administrators were contacted by the researcher through email with a formal request for participation in the study. When necessary, a follow-up phone call or email was sent to ensure that the administrators had a chance to ask questions or address concerns about the study. Once approval was granted by the administrator, the researcher offered to speak to the school's board (if one existed) to explain the upcoming study and the process involved in administering the survey. This activity was not requested by any of the participating schools. A standard note, as shown in Appendix 1, described the study, provided a link to the survey, detailed the incentive for participation, and was sent to each school administrator for distribution to the parents affiliated with their school. In most cases, each school maintained an active listserv or email list through which the note was posted for parents. Because the school administrator was posting the letter, it seemed to signal to parents that the survey was endorsed by the school and that they were encouraged to participate. Those parents who chose to participate in the survey followed the instructions in the letter and clicked on the link to the survey. The survey was made available online (using *SurveyMonkey*, an online survey tool) and contained an introductory consent page, pre-test questions, and survey questions. Following completion of the survey, participants were asked to return a copy of the final completion page URL from the survey to the researcher through email or submit a hardcopy of the final page to their school's administrator. In exchange, they were given a \$10 gift card for Baskin Robbins Ice Cream Store.

Survey Methodology

The protocol and survey was reviewed and approved by George Mason University's Human Subjects Review Board prior to initiating the research. The survey consists of a two-part questionnaire. The first portion provides an introduction to the survey, an informed consent form (which the reader was required to agree to before beginning the survey), and four pre-test questions related to their school affiliation and fish-consumption habits. The second portion of the survey asks general questions on the respondents' opinions of Web sites conveying fish-consumption guidelines, their environmental attitudes using five questions from the NEP scale (P. C. Stern et al., 1999), and demographics (also shown in Appendix 2). For reassurance, text was included to remind the respondents that this survey is intended to test the effectiveness of the Web sites—not to test the respondents' abilities.

The survey was conducted from October 18, 2010 and remained open until December 18, 2010; the online survey is available for viewing at <http://www.surveymonkey.com/s/N5H2XX7>). Results and findings from the survey are discussed in Chapter 4. Specific survey questions from the final survey are included in Appendix 2.

Pilot Test: Recommendations for Improvements to Survey

Prior to finalizing and distributing the survey, a pilot test was conducted to ensure that the research methodology and questions were appropriate and to identify potential “pitfalls”

in the study design or survey questions. The pilot test emulated the procedures proposed for the main study (Dillman, 2000) and also served as practice for the researcher to administer the survey and set expectations.

The pilot test was conducted with a small subset of parents from Maryland, Virginia, Pennsylvania, and New York, who fell within the target population for the study, parents (males and females) with young children (aged 6 months to 5 years). These tests were conducted from September 19, 2010 to October 3, 2010 on the online survey entitled, “Evaluating Characteristics of Web Sites used to Convey Environmental Risk Information Through Fish Advisories.”

The pilot tests were conducted with five females and one male. The researcher met with each of the six pilot-test participants individually. Each participant was asked to complete the survey online with the researcher sitting beside him or her or on the phone. They were encouraged to talk out loud as they completed the survey and pause to share thoughts or concerns along the way at his or her own pace. Each session lasted approximately 1 hour. Detailed findings from the pilot test are available in Appendix 4; resulting recommendations for improvements that were made to the survey are addressed below.

In order to shorten and clarify the title to make it easier for the respondent to understand, the title of the survey was changed from "Evaluating Characteristics of Web Sites used to

Convey Environmental Risk Information" to "Fishing for Information: A Study on Web Sites Conveying Fish Advisories." Additionally, a "progress bar" was inserted in the survey showing the amount of the survey that has been completed with each page.

The tone of the introductory text was changed from a formal explanation of the survey to one that allowed the respondent to relate to the purpose and goals of the study. This was done by using more natural language and by stating that their contribution to this project would help further the research in communicating environmental risks and in how these communications could be made more effective. Additionally, the survey's incentive (gift card) was also emphasized.

On the basis of the pilot-test participants' interest in the credibility of government sources of information, the researcher added two additional questions to the survey regarding trust. These additional questions asked respondents whether they would be more likely to trust this information if it were from a non-profit organization or from a private firm.

Some pilot-test participants suggested that the sites they viewed had little or no impact on their understanding of contaminants in fish or seafood. As a result, additional answer choices were added to allow the respondent to indicate no change in views.

Additional minor adjustments were made to the wording of the instructions and the questions to make them easier for the respondents to understand. Specific enhancements are shown in Appendix 4.

Pre-test and Survey Questions

In the survey, respondents were asked to complete a series of pre-test questions. Each respondent was asked to select the school his or her child attends, whether he or she felt it was safe to eat fish and seafood, how often the respondent and his or her family consume fish or seafood, and how often he or she recommends to others the consumption of fish or seafood. Additionally, respondents were asked to select the answer choice that corresponded with their last names in order to randomly assign them to either the California or Maryland Web site as a way of comparing design characteristics.

Following the pre-test questions, each participant was presented with one of the two state fish-advisory Web sites and was asked to spend at least five minutes surfing the site to familiarize himself or herself with it. This step was emphasized because many of the survey questions depended on the participant's experience with the site.

Next, participants were asked to rate various characteristics of the site and were encouraged to refer back to the Web site as often as they wanted to. Respondents were asked to rate the site's ease of use, its use of clear language and consistent technical terms, how easily they were able to scan the content on the site, the consistent placement

of links and use of page titles throughout the site, the ability to go back to an earlier page, and whether the site offered an opportunity for help if they felt they needed further information.

Respondents were also asked whether they felt the site they visited had a high degree of technical expertise, whether the information on the site appeared objective and unbiased, whether it appropriately reflected the pros and cons of fish consumption, whether information about contaminants was consistent from page to page throughout the site, and whether or not they felt the site contained honest, straightforward, and reliable information.

Two questions on their opinions of trust of the information were also posed to the respondents. They were asked whether they would be more likely to trust this information if it were from a non-profit organization. They were also asked if they would be more likely to trust this information if it were from a private firm.

Similar to the pre-test questions, respondents were asked how often their families would be consuming fish or seafood after visiting this site. They were also asked how often they would recommend the consumption of fish to others after visiting the site.

On the basis of their uses of the site, respondents were asked to select which contaminants could be of concern and may be present in fish. They were also asked to

select which positive and negative effects may occur when consuming fish. Respondents were also asked whether they discovered at least one type of fish consumed by their families that was listed as possibly contaminated.

Participants were asked whether, on the basis of their experiences with this site, they would prepare fish and seafood for their children more often, less often, or the same amount. They were asked whether they would check for more information on fish and seafood contamination on government or environmental Web sites in the future. One open-ended question was asked regarding the respondents' opinions on other aspects of the site that made it hard or easy to use.

In order to evaluate the respondents' perspectives on natural resources and the environment, five questions were asked on the existence of an "ecological crisis," the Earth's carrying capacity, propensity for ecological catastrophe, nature's ability to cope with the impacts of industrialization, and humans' treatment of the environment.

The last set of questions in the survey assessed the respondents' demographic characteristics. They were asked their gender, age range, race, employment status, educational status, family income, number of children, political affiliation, and whether any member of their family fish on a regular basis.

Quantification of Variables

In order to prepare the dependent and independent variables for statistical analysis, the researcher developed an approach to quantify and code them. An expanded explanation of the quantification techniques that were employed is included in Chapter 4. A summary of these techniques is included below.

The first dependent variable in the study measures the participants' knowledge of risk of fish consumption. The researcher calculated a "knowledge score" for each participant in the study based on their responses to three survey questions: Questions 17, 18, and 19 (see Tables 3-6 in Chapter 4). On the basis of the use of the Web site assigned in the survey, these three questions ask the respondent to select the contaminants of concern in fish-consumption guidelines, the negative effects of consuming fish that may be contaminated, and the positive effects of fish consumption.

Similarly, a "behavior change score" was calculated for the second dependent variable, the participants' intent to change behaviors with regard to fish consumption. The behavior change score was calculated using four questions or combination of questions from the survey: Pre-test Question 3 compared with Question 15, Pre-test Question 4 compared with Question 16, and Questions 21 and 22 (see Tables 7-13 in Chapter 4). These questions asked the respondents to select the frequency of their fish consumption and the frequency with which they recommend fish consumption to others before and after viewing the Web site assigned in the survey. On the basis of their uses of the Web

site, they were also asked about the frequency with which they will prepare fish for their children and how frequently they intend to check other Web sites for information on this issue in the future.

Scores were also quantified for three of the independent variables: Web site usability, Web site credibility, and environmental beliefs. The first two variables were analyzed using principal component analysis (PCA) followed by a reliability analysis. The resulting components of each variable were added together to derive a “usability score” and “credibility score” for each respondent. Similarly, the responses to the five NEP Scale questions were added together to derive an “environmental beliefs score” for each respondent. These five questions ask about the existence of an ecological crisis, the Earth’s carrying capacity, propensity for ecological catastrophe, nature’s ability to cope with the impacts of industrialization, and humans’ treatment of the environment. Social demographic influences were assessed independently in the regression models. Analysis techniques used to derive the above scores are explained in Chapter 4; analysis was conducted using the SPSS/PASW Version 18.0 software package.

In summary, this study surveys a purposive sample of parents (males and females) with young children (aged 6 months to 5 years) who reside in Maryland. This group was asked to rate characteristics of Web sites used to convey information on safe fish-consumption habits, focusing on the usability and credibility of the information presented. Additional questions regarding environmental beliefs and demographic

characteristics were also included in the survey. In order to employ the principles of triangulation, state communicators were also interviewed to obtain their perspectives on the importance of the usability and credibility of their Web sites. These quantitative and qualitative approaches are used to better understand the impacts of fish advisory Web sites on one's behavior and knowledge in terms of fish consumption.

CHAPTER 4: SURVEY RESULTS AND ANALYSIS

This chapter discusses the quantitative portion of this study, a survey conducted on parents with young children from the state of Maryland. The outcomes in this chapter outline the respondents' preferences about Web site usability, credibility, presentation format, environmental beliefs, and their demographic characterizations. Additionally, this chapter addresses how these factors influence the respondents' knowledge of the risks of fish consumption and their intent to change behavior in terms of fish consumption. These findings provide rich, accurate, and comprehensive descriptions of the experiences, attitudes, beliefs, and behaviors of the subjects.

A total of 108 survey responses were collected in this study and are the basis for the quantitative analysis outlined below. Of the total number of respondents, exactly half of the sample (54 respondents) was randomly assigned to view the state fish advisory from California; the other half viewed Maryland's site. Ten nursery schools facilitated parent participation in the survey and each school was of varying size and participated in different amounts. The researcher estimates a total population size of 413 families on the basis of the individual school totals as shown in Appendix 5. This translates into a 26% response rate for the survey administered in this study.

Because survey data are largely quantitative, they are easily subjected to statistical analysis. As a result, survey data, expressed as variables, can be used to define or assert the existence of certain constructs (Gillham, 2008). In this study, the researcher measures the participants' (1) knowledge of the risk of consuming fish and (2) their intent to change their behavior with regard to fish consumption, which are considered dependent variables. The impact of a number of independent variables on these dependent variables is assessed using means tests, correlations analysis, and regression analysis. These independent variables include the following: a Web site's usability, its credibility, its presentation format, the respondent's environmental beliefs, and their demographic profile.

Quantifying the Dependent Variables

Knowledge Score

In order to quantify the first dependent variable in the study, the participants' knowledge of risk of fish consumption, the researcher developed a "knowledge score." This dependent variable is measured on an interval scale and is calculated on the basis of the respondents' selections to Questions 17, 18, and 19 of the survey, as shown in Table 3 below. On the basis of the use of the Web site assigned in the survey, these three questions ask the respondent to select the contaminants of concern in fish consumption guidelines, the negative effects of consuming fish that may be contaminated, and the positive effects of fish consumption. As outlined in the quantifications below, each

respondent receives a knowledge score ranging from +10 (indicating a perfect knowledge score) to 0 (indicating no knowledge on the issue).

Table 3. Questions used to Assess Knowledge of Risks of Fish Consumption
The correct answers to the questions are bolded/red.

<p>Q.17. Based on my use of this site, I learned that the following contaminants could be of concern and may be present in fish (check all that apply):</p> <ul style="list-style-type: none">• Mercury• Arsenic• Formaldehyde• PCBs• None
<p>Q.18. Based on my use of this site, I learned that the following <u>negative</u> effects can be of concern when consuming fish (check all that apply):</p> <ul style="list-style-type: none">• There is potential for harm to the central nervous system of children and adults.• There are concerns related to obesity when consuming contaminated fish.• There are no harmful effects when consuming contaminated fish.• This site didn't change my view at all.
<p>Q.19. Based on my use of this site, I learned that the following <u>positive</u> effects are shown to exist when consuming fish (check all that apply):</p> <ul style="list-style-type: none">• Fish are a good source of high-quality protein and nutrients.• Consuming fish may help increase my bone density.• There are no beneficial effects when consuming fish.• This site didn't change my view at all.

Question 17 is measured on a scale of +4 to 0. The method for calculation is shown in Table 4 below.

Table 4. Quantifications for Survey Question 17

	IF Selected	IF NOT Selected
a. Mercury	+1	0
b. Arsenic	0	+1
c. Formaldehyde	0	+1
d. PCBs	+1	0
e. None	0	0

Question 18 is measured on a scale of +3 to 0. The method for calculation is shown in Table 5 below.

Table 5. Quantifications for Survey Question 18

	IF Selected	IF NOT Selected
a. Nervous system	+1	0
b. Obesity	0	+1
c. No harm	0	+1
d. No change in views	Case Removed (i.e., missing value)	Case Removed (i.e., missing value)

Question 19 is measured on a scale of +3 to 0. The method for calculation is shown in Table 6 below.

Table 6. Quantifications for Survey Question 19

	IF Selected	IF NOT Selected
a. Protein & nutrients	+1	0
b. Bone density	0	+1
c. No benefits	0	+1
d. No change in views	Case Removed (i.e., missing value)	Case Removed (i.e., missing value)

As shown in Tables 5 and 6 above, respondents that selected answer choice “d” in Questions 18 or 19 in the survey were removed from the analysis and coded as missing values. The intent of this survey is to measure respondents’ knowledge of risks of fish consumption on the basis of their use of state government fish-advisory Web sites. By selecting answer choice “d,” the respondent was stating that the Web site they viewed did not impact their knowledge of the negative or positive effects of fish consumption. Because these questions are a critical measure of the respondents’ knowledge based on their use of the site, these individuals did not receive a knowledge score and were removed from the analysis.

Behavior Change Score

In order to quantify the second dependent variable in the study, the participants’ intent to change their behavior with respect to fish consumption, the researcher developed a “behavior change score.” This dependent variable is measured on an interval scale and is calculated on the basis of the respondents’ selections to Pre-test Questions 3 and 4, as

well as, Survey Questions 15, 16, 21, and 22, as shown in Table 7 below. These questions ask the respondent to select the frequency of their fish consumption and the frequency with which they recommend fish consumption to others before and after viewing the Web site assigned in the survey. On the basis of their use of the Web site, they were also asked about the frequency with which they will prepare fish for their children and how frequently they intend to check other Web sites for information on this issue in the future.

Respondents were asked their intention in terms of fish consumption before viewing the state fish-advisory site (in the survey's pre-test questions) and after viewing the site. This allowed the researcher to measure the respondents' intent to change behavior and the amount of change was measured directionally (i.e., amount of positive change, an increase in fish consumption, or amount of negative change, a decrease in fish consumption). On the basis of the quantifications outlined below, each respondent received a behavior change score ranging from +8 (indicating the most dramatic change in behavior in the positive direction, resulting in an increase in fish consumption) to -10 (indicating the most dramatic change in behavior in the negative direction, resulting in a decrease in fish consumption).

Table 7. Survey Questions Used to Assess Intention to Change Fish Consumption Behavior

<p>Pre-test Q.3. My family and I consume fish and/or seafood: (Frequency scale is included.)</p> <p>COMPARED TO</p> <p>Q.15. <u>After surfing this site</u>, my family and I are likely to consume fish and/or seafood: (Frequency scale is included.)</p>
<p>Pre-test Q.4. I have recommended to others to consume fish and/or seafood: (Frequency scale is included.)</p> <p>COMPARED TO</p> <p>Q.16. <u>After surfing this site</u>, I would recommend others to consume fish and/or seafood: (Frequency scale is included.)</p>
<p>Q.21. Based on my experience with this site, I will prepare fish and seafood for my children: (Frequency scale is included.)</p>
<p>Q.22. Based on my experience with this site, I will check for more information on fish and seafood contamination on government or environmental Web sites: (Frequency scale is included.)</p>

Pre-test Question 3 and Survey Question 15 are calculated using the method outlined in Tables 8 and 9 below. The higher score value indicates a greater intended change in behavior either in the positive direction (resulting in an increase in fish consumption) or in the negative direction (resulting in a decrease in fish consumption). This set of questions is measured in terms of a directional change and the range of scores for this question is +3 to -3.

Table 8. Quantifications for Pre-test Questions Compared with Survey Question 15

	About once or twice a week	About once or twice a month	A few times a year	Never
PT Q.3. My family and I consume fish and/or seafood:	A	B	C	D
Q.15. <u>After surfing this site</u> , my family and I are likely to consume fish and/or seafood:	E	F	G	H

Table 9. Response Options for Pre-test Question 3 Compared with Survey Question 15

Response Combination	Amount of Change	Value
A & E	No change	0
A & F	Small change	-1
A & G	Moderate change	-2
A & H	Dramatic change	-3
B & E	Small change	1
B & F	No change	0
B & G	Small change	-1
B & H	Moderate change	-2
C & E	Moderate change	2
C & F	Small change	1
C & G	No change	0
C & H	Small change	-1
D & E	Dramatic change	3
D & F	Moderate change	2
D & G	Small change	1
D & H	No change	0

Pre-test Question 4 and Survey Question 16 are calculated using the method outlined in Table 10 and 11 below. The higher score value indicates a greater intended change in behavior (either positive or negative). This set of questions is measured in terms of a directional change and the range of scores for this question is +3 to -3.

Table 10. Quantification for Pre-test Question 4 Compared with Survey Question 16

	About once or twice a week	About once or twice a month	A few times a year	Never	N/A
PT Q.4. I have recommended to others to consume fish and/or seafood:	A	B	C	D	E [Case Removed (i.e., missing value)]
Q.16. <u>After surfing this site</u> , I would recommend others to consume fish and/or seafood:	F	G	H	I	[Response option not included in survey]

Table 11. Response Options for Pre-test Question 4 Compared with Survey Question 16

Response Combination	Amount of Change	Value
A & F	No change	0
A & G	Small change	-1
A & H	Moderate change	-2
A & I	Dramatic change	-3
B & F	Small change	1
B & G	No change	0
B & H	Small change	-1
B & I	Moderate change	-2
C & F	Moderate change	2
C & G	Small change	1
C & H	No change	0
C & I	Small change	-1
D & F	Dramatic change	3
D & G	Moderate change	2
D & H	Small change	1
D & I	No change	0

The values of Survey Questions 21 and 22 were calculated using the method outlined in Tables 12 and 13 below. Because there was no comparable question asked in the pre-test of the survey, there was little value in calculating the non directional value of these responses. These sets of questions are measured in terms of a directional change and the range of scores for this question is +1 to -2.

Table 12. Quantifications for Survey Question 21

	More often	About the same as before	Less often	Never
Q.21. Based on my experience with this site, I will prepare fish and seafood for my children:	A (value = 1)	B (value = 0)	C (value = -1)	D (value = -2)

Table 13: Quantification for Survey Question 22

	More often	About the same as before	Less often	Never
Q.22. Based on my experience with this site, I will check for more information on fish and seafood contamination on government or environmental Web sites:	A (value = 1)	B (value = 0)	C (value = -1)	D (value = -2)

As shown in Table 10 above, respondents that selected answer choice “e” in Pre-test Question 4 in the survey were removed from the analysis and coded as missing values. Pre-test Question 4 asks respondents the frequency with which they intend to recommend the consumption of fish. Answer choice “e” allowed respondents to select that they tend not to make such recommendations to other individuals (as opposed to not making a recommendation based on concerns about fish consumption). Question 16 in the survey

asks respondents to select their intended behavior on this issue after viewing the Web site. The comparison of these responses was then used as one measure of intended behavior change in the analysis.

In the process of developing the survey, the researcher failed to provide a corresponding answer choice of “e” in Question 16. Due to this oversight, it was not possible to know whether certain respondents would have selected this answer choice had it been made available in Question 16. As a result, the researcher felt it was prudent to remove the individuals that selected answer choice “e” in Pre-test Question 4 from the analysis.

Quantifying the Independent Variables

Web Site Usability

The Web site’s usability is measured through the respondents’ answers to Questions 1-7 in the survey. These questions ask respondents to rate the site’s ease of use, its use of clear language and consistent technical terms, how easily they were able to scan the content on the site, the consistent placement of links and use of page titles throughout the site, the ability to go back to an earlier page, and whether the site offered an opportunity for help if they felt they needed further information.

Of these questions, the researcher wanted to determine which components or factors were best to measure usability and, therefore, conducted a principal component analysis (PCA) on its factors. Using PCA, a large number of independent variables or factors can be

systematically reduced to a smaller, conceptually more coherent set of variables. These “principle components” are a linear combination of the original variables (Dunteman, 1989). In this study, PCA is conducted on the following components of usability that formed the basis for Questions 1-7 of the survey: the site’s ease of use, use of simple and natural language, scannability of the site, consistent terminology and navigation, an easy exit provided, and the opportunity for help provided.

The goal of conducting such an analysis on the site’s usability was to create an index of usability that can be used not only as the basis for comparison of the two state-issued fish advisories, but also broadly as a scale of usability for this and future studies on this variable. This approach, similar to that outlined in Slimak (2003), would in theory facilitate the development of an index of usability.

Prior to conducting the PCA, the researcher verified whether any variables were identified as problematic in the data screening as advised by Field (2009). This was done by generating a correlation matrix in order to check for the intercorrelation between variables. Typically, variables with low correlation (below .3) or high correlation (above .8) are removed from the analysis. One component showed values just below .3; however, it was retained in the analysis to allow the researcher to observe its effect on the following PCA and reliability analyses.

PCA was conducted in SPSS by selecting the variables associated with Questions 1-7 in the survey, with the use of an extract of eigenvalues over 1 (the default in SPSS) and using the varimax rotation. The resulting component matrix shows a one-component solution, essentially showing that all of the factors associated with usability “fell together” and are measuring unique characteristics of usability. This shows that there is one underlying component or dimension joined by a common variance showing that these seven components are all dimensions of usability.

As a result of the PCA findings, all of the components of usability are retained and added together to develop a single “usability score.” In order to understand the internal consistency of this score, a reliability analysis was conducted in SPSS using Cronbach’s alpha (where a Cronbach’s alpha value of 0.6 or below represents low internal consistency). Such a technique considers intercorrelations as well as measures the “unidimensionality,” or the extent to which the scale measures one underlying factor or construct. This interpretation stems from the fact that, when there is one factor underlying the data, alpha is a measure of the strength of that factor (Field, 2009). The results of the reliability analysis show that the alpha value of the usability score is 0.84.

The researcher considered how all the items or components of usability correlate with the total alpha, to further the reliability analysis. According to Field (2009), in a reliability scale, all items should correlate with the total and corrected item-total correlation values that are less than about .3 do not correlate very well with the scale overall and should be

removed. In this case, none of the assessed items exhibit a low corrected item-total correlation value. As a result, the seven measures of usability were added together to compute a usability score variable. This score represents how respondents rate the usability of the site they visited and ranges from a value of 5 (indicating a low usability ranking) to 35 (indicating a high ranking).

Web Site Credibility

The same approach as outlined in the Web site usability section above was taken when developing a measure for Web site credibility. The Web site's credibility was measured through the respondent's answers to Questions 8-12 in the survey. Through these questions, respondents were asked whether they felt the site they visited had a high degree of technical expertise, whether the information on this site appeared objective and unbiased, whether it appropriately reflected the pros and cons of fish consumption, whether information about contaminants was consistent from page to page throughout the site, and whether or not they felt the site contained honest, straightforward, and reliable information. When analyzing the findings, PCA was conducted on the following components of credibility that formed the basis for Questions 8-12 of the survey: perceived competence, objectivity, fairness, consistency, and a perception of good will.

Prior to conducting the PCA, the researcher verified whether any variables were identified as problematic in the data screening as advised by Field (2009). This was done by generating a correlation matrix in order to check for the intercorrelation between

variables. Variables with low correlation (below .3) or high correlation (above .8) were removed from the analysis.

PCA was conducted in SPSS by selecting the variables associated with Questions 8-12 in the survey, using an extract of eigenvalues over 1 (the default in SPSS) and using the varimax rotation. The resulting component matrix shows that only one component was returned, essentially showing that all of the factors associated with credibility fell together. This shows that there is one underlying component or dimension joined by a common variance, showing that these five components are all distinct dimensions of credibility.

Next, a reliability analysis was conducted in SPSS in order to generate a “scale score” by removing items with a low coefficient alpha (by measuring a Cronbach’s alpha value of 0.6 or below). The results of the reliability analysis show an alpha of 0.83 for the credibility score. None of the corrected item-total correlation values were below .3 (indicating that the item does not correlate very well with the scale overall), and, therefore, no components were removed. The five measures of credibility were added together to compute a credibility score variable. This score represents how respondents rate the credibility of the site they visited and ranges from a value of 5 (indicating a low credibility ranking) to 25 (indicating a high ranking).

Environmental Beliefs

During data analysis, an additional index was created using the dichotomous responses from the New Ecological Paradigm (NEP) questions used to measure the respondents' environmental attitudes. Slimak (2003) reports an alpha reliability of 0.77 for the five NEP questions used in this study. Building on the factor analysis of the NEP questions conducted by Slimak (2003), an additive scale of NEP questions was created. The total of the “agree” or “disagree” responses to survey Questions 24-28 from each respondent were added for a total, individual score on one's environmental beliefs, as shown in Table 14 below.

Table 14. Quantification Methodology for Survey Questions 24-28

	IF Selected	IF NOT Selected
Q.24. The so-called “ecological crisis” facing humankind has been greatly exaggerated.	0	+1
Q.25. The earth is like a spaceship with very limited room and resources.	+1	0
Q.26. If things continue on their present course, we will soon experience a major ecological catastrophe.	+1	0
Q.27. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	0	+1
Q.28. Humans are severely abusing the environment.	+1	0

The responses to these questions were computed and recoded to create an “environmental beliefs score.” The range of scores for this new variable is 5 (indicating adherence to the NEP and, therefore, a highly environmentally conscious respondent) to 0 (indicating little consciousness on environmental issues).

Respondent Profile and Summary of Findings

In order to identify trends within the data, simple statistical procedures and plots were conducted by the researcher. Frequency tables and descriptive statistics allowed the researcher to look at how often different values occur, to determine what summary measures best describe the data, and to examine simple relationships between variables. These procedures are necessary to, not only identify trends and other dynamics among the data, but also to prepare for more rigorous statistical evaluation covered later in this chapter. The various observations from the frequencies and descriptive statistics as gleaned by the researcher are addressed below.

The demographic characteristics of the sampled population are summarized in Table 15 below. The sampled population is predominately female (86%). The mode category for age is 30-39 years, with the majority of the respondents falling between the ages of 30-39 years (73%). The respondents to the survey are primarily Caucasian (82%). A large portion of the sample characterized themselves as unwaged caregivers (41%), whereas the remainder of the group is employed or formerly employed (either part time, full time, self-employed, or unemployed). The respondents are highly educated with 42% having

completed some college or graduated from college and 55% being graduate school educated, with the mode category for education being graduate school educated. The respondents are also highly paid with 75% earning above \$91,000 a year [which is close to the mean household income of Montgomery County, Maryland residents (U.S. Census Bureau, 2008)] and approximately 28% of respondents earning \$131,000 or more per year. Most respondents have either two children (45%) or three children (29%), with 2.26 mean number of children. Approximately a third of the group (35%) regularly fish or have a member of their family that regularly fish. Lastly, the survey respondents are predominantly liberal (52%) in their political affiliation.

As revealed by these demographic characteristics, the respondents to the survey are primarily of one race (Caucasian), are very highly paid, and are highly educated. On the basis of these characteristics, the sampled population represents members from a high socioeconomic status. As such, the findings from the survey may not be indicative of members of lower socioeconomic status, representing a threat to this study's validity and reliability. However, approximately one-third of the sampled population regularly fish or have a member of their family that regularly fish. Individuals such as these are appropriate to evaluate state-issued fish advisories because their dietary habits may be most impacted by these communications.

Table 15. Summarized Demographic Characteristics of Sampled Population
(The mode or mean is shown in bold, representing the predominant category.)

Demographic Characteristic (n=108)	Frequency (Percent)
<i>Gender:</i> Male Female	15 (13.9) 93 (86.1)
<i>Age Range, years:</i> 20-29 30-39 40-49 50-59 60+	6 (5.6) 79 (73.1) 21 (19.4) 1 (.9) 1 (.9)
<i>Race:</i> African American Asian Caucasian Hispanic Other	3 (2.8) 11 (10.2) 89 (82.4) 2 (1.9) 3 (2.8)
<i>Caregiver Status:</i> Full time employed Part time employed Unemployed Self-employed Unwaged caregiver	37 (34.3) 19 (17.6) 1 (.9) 6 (5.6) 45 (41.7)
<i>Educational Status:</i> High school graduate Some college or college graduate Graduate school	2 (1.9) 46 (42.6) 60 (55.6)
<i>Family Income, per year:</i> Below \$50,000 \$51,000 to \$70,000 \$71,000 to \$90,000 \$91,000 to \$110,000 \$111,000 to \$130,000 Above \$131,000	5 (4.6) 10 (9.3) 11 (10.2) 26 (24.1) 26 (24.1) 30 (27.8)
<i>Number of Children:</i> 1 child 2 children 3 children 4 children 5 or more children	20 (18.5) 49 (45.4) 32 (29.6) 5 (4.6) 2 (1.9)
<i>Fishing Status:</i> Yes No	38 (35.2) 70 (64.8)
<i>Political Affiliation:</i> Liberal Independent Conservative Other	57 (52.8) 28 (25.9) 20 (18.5) 3 (2.8)

Summary of Findings from t-Tests for Equality of Means

To begin the analysis of the survey responses, the researcher conducted an independent-samples t-test for the equality of means in order to detect significant differences among the respondents that viewed the Maryland fish-advisory Web site and those that viewed California's site. This analysis allows the researcher to test Hypothesis 3, which suggests that the narrative-based presentation format will have a greater influence than the graphical format on knowledge of risks and intended change in behavior. This analysis also allows the researcher to determine whether the Web site presentation format impacts the usability or credibility of the site, as shown on the left side of the conceptual framework in Figure 3 (presented in Chapter 2). It also allows the researcher to detect other impacts that the presentation format may have on the respondents' perceptions of trust, environmental beliefs, knowledge score, or behavior change score.

The independent-samples t-test performed on the independent and dependent variables in this study show that there are no significant differences between the means for any of these variables when considering Web site presentation format. As a result, it does not appear that one's knowledge of the risks of fish consumption, intended change in behavior, perceived usability, credibility, trust of information sources, or ecological beliefs are greatly affected by the online presentation format of an environmental risk. A detailed discussion of each of these variables follows below.

Web Site Usability

Overall, the usability of both sites ranks low, as shown in Table 16 below, and the mean scores for the two sites are almost identical. The California site scored a mean of 13.0 out of a usability score of 5 to 35; the Maryland site scored 12.9. There is no significant difference ($p = .938$) among the means (when using a t-test for the equality of means evaluating independent samples at the 95% confidence level). This indicates that there is no significant difference among the mean usability score of the narrative site (Maryland) as compared to the graphical site (California).

Table 16. Average Scores for Independent and Dependent Variables

Variable	Mean Values for Maryland Fish-Advisory Web site Respondents	Mean Values for California Fish-Advisory Web site Respondents	t-Value (Significance Value)* (2-tailed)
Usability Score (max = 35)	12.92	13.0	-.077(p= .938)
Credibility Score (max = 25)	9.26	8.67	.947 (p= .346)
I would be more likely to trust this information if it were from a <u>non-profit</u> organization. (max = 5)	2.59	2.56	157 (p= .875)
I would be more likely to trust this information if it were from a <u>private firm</u> . (max = 5)	3.50	3.83	-1.51 (p= .133)
Behavior Change Score (range = +8 to -10)	.82	.55	.761 (p= .450)
Knowledge Score (max = 10)	9.22	9.38	-.623 (p= .536)
Environmental Beliefs Score (max = 5)	3.91	3.93	-.075 (p= .941)

*Significance of t-test for equality of means (independent samples)

Web Site Credibility

Overall, the credibility of both sites ranks low, as shown in Table 16 above. However, the Maryland state fish-advisory Web site ranked slightly higher in credibility than the California advisory, as evidenced by fewer “strongly disagree” and “slightly disagree” selections to the survey questions and a slightly higher mean score. The Maryland site scored a mean of 9.26 out of a credibility score of 5 to 25; the California site scored 8.67, as shown above. This slight increase in the credibility score for the Maryland Web site may be attributable to the fact that respondents are residents of Maryland. The respondents may have some bias toward the information on the Maryland site because they reside in that state. Regardless, there is no significant difference ($p = .346$) among the means, indicating that there is no significant difference among the mean credibility score of the narrative site (Maryland) as compared to the graphical site (California).

Trust in Non-Profit and Private Sources

The questions relating to trust of the source of the information (Survey Question 13 focusing on non-profit sources of information and Survey Question 14 focusing on private sources) show a greater amount of trust if a private firm were the source (as opposed to a non-profit organization) for both Web sites, as shown in Table 16. The fact that respondents show a greater amount of trust in private-firm information sources is consistent with the findings reported by Rowan (2010). Rowan (2010) reports findings from a study conducted by Priest and colleagues in which the researchers found that, in the United States, there is a greater trust in industry than in government and

environmental groups in terms of biotechnology. However, there is no significant difference ($p = .875$; $p = .133$) among the means for Questions 13 or 14, indicating that there are no significant differences among the mean scores for trust of the information with respect to the narrative site (Maryland) as compared to the graphical site (California).

Respondents' Intent to Change Behavior

In terms of the participants' intent to change behavior with regard to fish consumption, the majority of respondents, regardless of which site they were evaluating, show no intention to change their behavior with regard to fish consumption, as shown in Table 17 below. Forty-two percent of respondents viewing Maryland's site report no intention to change their behavior, and 39% of the respondents viewing California's site report no intention to change their behavior.

Of those respondents that report an intention to change their behavior, the majority of the change is positive (indicating an increase in the consumption of fish). Six percent of the respondents that viewed the Maryland site and intend to make a change in their behavior report a negative change, and 51% exhibit a desire to change their behavior in a positive fashion. Of those respondents that viewed the California site and intend to make a change in their behavior, only 13% exhibit a negative change and 48% exhibit a desire to change their behavior in a positive fashion.

Table 17. Overall Behavior Change Score Statistics for Sampled Population

Web Site Selection & Behavior Change Score (ranging from +8 to -10)	Frequency	Valid Percent⁴
<i>Maryland Fish-Advisory Web site:</i>		
-4.0	1	3.0
-3.0	1	3.0
0	14	42.4
1.0	6	18.2
2.0	6	18.2
3.0	4	12.1
4.0	1	3.0
Missing values	21	N/A
<i>California Fish-Advisory Web site:</i>		
-1.0	4	12.9
0	12	38.7
1.0	13	41.9
4.0	2	6.5
Missing values	23	N/A

Additionally, as shown in Table 16, the mean behavior change score for participants viewing the Maryland fish-advisory site is slightly higher than those viewing California's site; however, there is no significant difference ($p = .450$) among the means, indicating that there is no significant difference among the mean behavior change score of the narrative site (Maryland) as compared to the graphical site (California).

⁴ The Valid Percent column is reported (as opposed to the Percent column) because this column excludes the missing cases and gives percentages for only those having provided a response (Dietz & Kalof, 2009).

According to these findings, when an intention to change behavior is indicated, these sites seem to influence change in the positive direction. However, these findings imply that the Maryland and California Web sites have little influence on the respondents' intention to change their behavior. They also imply that the type of Web site is not significantly influencing their behavior.

To delve deeper into the measure of the behavior change score, two of the four questions used to measure behavior change are discussed further because they show interesting findings. The propensity of parents to change the frequency with which they prepare fish and seafood for their children (Survey Question 21) is included in the measure of the behavior change score above. This statistic reveals little intended change in behavior and is addressed separately in Table 18 below. No respondent plans to prepare fish more often for their children on the basis of either the Maryland or California sites, and the vast majority of respondents do not intend to change their behavior in terms of preparing fish and seafood for their children.

Table 18. Response to Survey Question 21
 “Based on my experience with this site, I will prepare fish and seafood for my children”

Web Site Selection & Response Choices	Frequency	Percent
<i>Maryland Fish-Advisory Web site:</i>		
More often	0	0
About the same as before	51	94.4
Less often	2	3.7
Never	1	1.9
<i>California Fish-Advisory Web site:</i>		
More often	0	0
About the same as before	52	96.3
Less often	2	3.7
Never	0	0

Similarly, the propensity of parents to seek additional information on fish and seafood contamination is measured as part of the behavior change score above. This statistic shows that a fairly large portion of the respondents intend to seek more information on this subject in the future. The response to this question is addressed separately in Table 19 and shows that 41% of Maryland’s Web site respondents and 39% of California’s Web site respondents intend to check for more information of this nature on government or environmental Web sites in the future, but no significant differences were observed.

Table 19. Response to Survey Question 22
 “Based on my experience with this site, I will check for more information on fish and seafood contamination on government or environmental Web sites”

Web Site Selection & Response Choices	Frequency	Percent
<i>Maryland Fish-Advisory Web site:</i>		
More often	22	40.7
About the same as before	31	57.4
Less often	0	0
Never	1	1.9
<i>California Fish-Advisory Web site:</i>		
More often	21	38.9
About the same as before	31	57.4
Less often	1	1.9
Never	1	1.9

Respondents’ Knowledge of Risks

As shown in Table 16 above, the mean knowledge score for participants does not differ a great deal; however, participants viewing the California fish-advisory site score a slightly higher mean knowledge score than those viewing Maryland’s site. These means do not significantly differ ($p = .536$), indicating that there is no significant difference among the mean knowledge score of the narrative site (Maryland) as compared to the graphical site (California).

Results related to the participants’ knowledge of the risk of fish consumption show that most participants score well (7 or above on a scale of 10), as shown in Table 20. This means, of those participants that felt they learned something about fish contamination on

the basis of their use of the site, many were selecting the correct answers regarding contaminants of concern and negative and positive effects of fish consumption. As shown by Hicks, Pivarnik, & McDermott (2008), stories pertaining to the positive and negative effects of consuming fish have dramatically increased over the last 5 years. Therefore, this increased attention may be influencing this skewed distribution of knowledge. The findings of this study show that, even though the mean knowledge score for each site does not significantly differ, the results show that a greater number of respondents who viewed the California site scored a perfect knowledge score (65%) as compared to the Maryland respondents (52%).

Table 20. Knowledge Score Statistics

Web Site Selection & Knowledge Score (ranging from +10 to 0)	Frequency	Valid Percent⁵
<i>Maryland Fish-Advisory Web site:</i>		
7.0	3	11.1
8.0	2	7.4
9.0	8	29.6
10.0	14	51.9
Missing values	27	N/A
<i>California Fish-Advisory Web site:</i>		
7.0	3	8.8
8.0	3	8.8
9.0	6	17.6
10.0	22	64.7
Missing values	20	N/A

⁵ The Valid Percent column is reported (as opposed to the Percent column) because this column excludes the missing cases and gives percentages for only those having provided a response (Dietz & Kalof, 2009).

A large portion of the respondents from both sites felt the site they viewed did not change their views (or knowledge) at all. This group of respondents is coded as a missing value as shown in Table 20. In total, 47 participants in the study (out of a total of 108) did not change their views on the basis of the information that was presented in the site they viewed. These individuals were removed from the analysis because the intent of this survey is to measure respondents' knowledge of risks of fish consumption based on their use of state government fish-advisory Web sites. By selecting that there was no change in their views, the respondent was stating that the Web site they viewed did not impact their knowledge of the negative or positive effects of fish consumption. Because these questions are a critical measure of the respondents' knowledge based on their use of the site, these individuals did not receive a knowledge score and were removed from the analysis.

Environmental Beliefs

In terms of the environmental beliefs score, which was measured on a scale of 0 to 5, the mean score of participants viewing either site was almost identical, as shown in Table 16 above. These means do not significantly differ ($p = .941$), indicating that there is no significant difference among the mean environmental beliefs score of the narrative site (Maryland) as compared to the graphical site (California). Additionally, as shown in Table 21, approximately half of the respondents to either site score the highest possible ecological beliefs score, indicating a large group of highly environmentally conscious respondents on the basis of the definitions set forward in this study.

Table 21. Distribution of Ecological Beliefs Score Ratings

Web Site Selection & Ecological Beliefs Score (ranging from 0 to 5)	Frequency	Percent
<i>Maryland Fish-Advisory Web site:</i>		
0	1	1.9
1	3	5.6
2	5	9.3
3	9	16.7
4	9	16.7
5	27	50.0
<i>California Fish-Advisory Web site:</i>		
0	0	0
1	0	0
2	11	20.4
3	8	14.8
4	9	16.7
5	26	48.1

On the basis of these observations and other findings presented above, the independent-samples t-tests performed on the independent and dependent variables in this study show that there are no significant differences between the means for these variables when considering the Web site presentation format. As a result, there are no differences in one's knowledge of the risks of fish consumption, intended change in behavior, perceived usability, credibility, trust of information sources, or ecological beliefs linked to the differences in a Web site presentation format of an environmental risk. The findings of this analysis do not allow the researcher to accept the study's third hypothesis that the narrative presentation format influences one's knowledge or risks or reported intention to consume fish. The next phase of analysis moves beyond evaluating the differences of

means to evaluating linear multiple regression models for each of the two dependent variables in this study.

Findings from Linear Multiple Regression

In order to address the research question and support or not support the five hypotheses in this study and derive other exploratory findings, the researcher used a linear multiple regression model to examine the relationship of the first dependent variable in this study, the participants' knowledge of the risk of fish consumption, with the independent variables in the study. A second linear multiple regression model is used to evaluate the relationship of the second dependent variable, the participants' intent to change behavior with regard to fish consumption, with the independent variables in this study.

Prior to conducting the regression analysis, the researcher produced a correlation matrix of all of the dependent and independent variables in the study. The results of the correlation matrix show a number of significant correlations. However, even though these correlations are significant, most of the associated correlation coefficients are small, indicating weak relationships. Significant correlations involving the dependent variables include the following: knowledge score and gender ($r = .278$; $p = .030$), behavior change score and age ($r = .253$; $p = .044$), and behavior change score and Survey Question 14 ("I would be more likely to trust this information if it were from a private firm.") ($r = -.267$; $p = .033$). This means that males are significantly correlated with a higher knowledge score, that younger respondents are significantly correlated with a higher behavior change

score, and that a decrease in trust in private sources of information is significantly correlated with a higher behavior change score.

A number of significant correlations involving only the independent variables were observed by the researcher. The most notable significant correlations included usability score and credibility score ($r = .651$; $p = .000$) and one's fishing status and the Web site presentation format ($r = .233$; $p = .015$). The significant correlation between the usability and credibility score is noteworthy because this outcome shows that, if a Web site is not perceived as usable, then it may also not be seen as credible by the user. The significant correlation between one's fishing status and the site's presentation format may show that certain presentation formats are more effective for the portion of the population that is actively fishing. The findings from the correlation matrix, in addition to theoretical considerations, assisted the researcher in determining which variables and interaction terms to consider when conducting multiple regressions.

Logistic Regression Addressing Participants' Knowledge

The respondents' knowledge score serves as the dependent variable in the analysis. The researcher ran a series of regressions, progressively adding to the number of independent variables to evaluate the relationship of the independent variables on the dependent variable, as shown in Table 17. The parameters for sample size as defined by Cohen (1992) were followed in this study, which specify a minimum of 50 participants to detect

a large effect at the .05 level using an eight variable regression. Due to constraints with sample size, a maximum of eight variables is used in each model.

The total sample for the regression consists of 61 participants. In total, 47 participants in the study (out of a total of 108) did not change their views based on the information that was presented in the site they viewed. These individuals were removed from the analysis because the intent of this survey is to measure respondents' knowledge of risks of fish consumption on the basis of their use of state government fish-advisory Web sites.

The researcher began this portion of the analysis using the ordinary least squares regression analysis method. Because the researcher had no assumptions on the preferred order for the entry of the independent variables in the regression model, the enter method was used. Assumptions for normality, linearity, and constant variance were tested using various plots of the residuals. Multicollinearity, a measure of multiple correlation within the variables when regressed, was measured using the tolerance, and variance inflation factor (VIF) values and were not of concern. The knowledge score did not meet the assumption of normality; transformation of the data was computed by adding a value of one (+1) to the data to correct for missing values in the data. Using this variable, data transformations (including log, square root, reciprocal, and reverse score) were attempted by the researcher but did not improve the normality of the dependent variable.

In addition to a non-normal distribution, the knowledge score measure was constrained. The theoretical range for this value is 0 to 10; however, the data collected vary between 7 and 10. Due to these deficiencies, the researcher conducted a binary logistic regression and recoded the dependent variable into a dichotomous form (“perfect knowledge score” and “imperfect knowledge score”). The findings of the logistic regressions are presented as three models in Table 22. Model 1 considers three independent variables from this study; Model 2 considers the addition of control variables, and Model 3 incorporates interaction terms. Some of these variables were chosen for analysis on the basis of their significant correlations revealed through the correlation matrix. In Table 22, the standardized beta values are reported for each variable with the standard errors shown in parentheses. The 90% confidence intervals (CI) for the odds ratio are shown in brackets. The first value in the bracket represents the lower bound limit; the second value represents the odds ratio; the third value represents the upper bound limit.

Table 22. Effects of the Study's Independent Variables on Knowledge Score Using Logistic Regression

Variable	Model β (SE) [LB<Odds>UB]		
	1	2	3
Web site presentation format	.50 (.53) [.69<1.64>3.93]	.45 (.57) [.61<1.56>3.98]	.45 (.57) [.61<1.57>4.02]
Usability score	.05 (.08) [.92<1.05>1.20]	.05 (.09) [.91<1.06>1.22]	.04 (.22) [.72<1.04>1.50]
Credibility score	-.05 (.12) [.78<.96>1.17]	-.07 (.13) [.75<.93>1.16]	-.10 (.33) [.52<.91>1.58]
Ecological beliefs score		.44* (.25) [1.04<1.56>2.35]	.44* (.25) [1.03<1.56>2.36]
Gender		-1.33* (.76) [.08<.26>.93]	-.42 (5.96) [.00<.66>11989.00]
Level of education		.12 (.59) [.43<1.12>2.94]	.14 (.65) [.40<1.15>3.37]
Usability score x Credibility score			.00 (.02) [.97<1.00>1.04]
Gender x Level of Education			-.25 (1.61) [.06<.78>11.11]
Model Fit Statistics			
Number of observations	61	61	61
Cox & Snell R ²	.02	.12	.12
Nagelkerke R ²	.03	.17	.17
Hosmer and Lemeshow Test	3.99	6.49	9.03

*p < .10

Standardized beta values are reported for each variable with standard errors (SE) shown in parentheses. 90% CI for odds ratio are in brackets [Lower Bound<Odds Ratio>Upper Bound].

All of the models presented in Table 22 have low R squared values and are not significant, showing that none of the independent variables evaluated in the model increase the predictability of a perfect knowledge score. However, two variables in

Model 2 and one variable in Model 3 are significant on their own. In Model 2, whereas the overall model is not significant, one's ecological beliefs ($B = .44$; $p = .07$) and gender ($B = -1.33$; $p = .08$) are significant predictors of the probability of a perfect knowledge score. In other words, the probability that a respondent will score a perfect knowledge score of the safety of fish consumption increases as their ecological beliefs score increases.

These results are not surprising given that respondents that are more attuned to the sensitivity of issues on environmental degradation will likely know more about the risks associated with consuming fish. In a study conducted by Hicks, Pivarnik, & McDermott (2008), the researchers observed that the majority of their survey respondents exhibited uncertainty or disagreement with environmental statements about overfishing. Their respondents also exhibited very low levels of self-reported knowledge about seafood. Whereas the respondents' environmental beliefs and knowledge were not significantly related in Hicks, Pivarnik, & McDermott (2008), this trend seems to comport with the findings in this study. This result supports Hypothesis 4 of this study and indicates that one's attitude about environmental concerns, as measured by the NEP, positively influences the effectiveness in communicating knowledge about the health risks related to fish consumption.

The findings of this study also show that male respondents have a higher probability of scoring a perfect knowledge score, in comparison to female respondents. To say it

another way, female respondents are one-quarter (.26) times likely to score a perfect knowledge score, as compared to men (90% CI = .08-.93). Therefore, it is less likely that a female respondent would score a perfect knowledge score, as compared to a male respondent. These findings seem surprising and are not consistent with outcomes observed by Lando and Zhang (2011) in their survey on awareness and knowledge of methylmercury (MeHg) in fish in the United States. Lando and Zhang (2011) report that female respondents in all age classes had greater improvements in their awareness of mercury in fish and knowledge of the information contained in the national advisories about mercury contamination in fish. Regardless of this inconsistency, the results of the analysis in this study support Hypothesis 5 and indicate that certain social demographic influences impact the effectiveness in communicating knowledge about the health risks related to fish consumption.

In Model 3, as shown in Table 22, only the ecological beliefs ($B = .44$; $p = .08$) score is significant, and gender is no longer significant. This could be due to the fact that an interaction term on gender and level of education was added in Model 3. A respondent's level of education is not a significant predictor of the probability of a perfect knowledge score on its own; however, by adding the interaction term, gender may have less of an influence on knowledge.

Exploratory Analysis on Participants Reporting No Change in Knowledge

As addressed earlier, the analysis on the respondents' knowledge did not include individuals that report no change in their knowledge of risks on the basis of the Web site they viewed. As a result, the total sample for the regression consisted of 61 participants because 47 participants in the study (out of a total of 108) did not change their views on the basis of the information that was presented in the site they viewed.

These individuals were removed from the analysis because the intent of this survey is to measure respondents' knowledge of risks of fish consumption on the basis of their use of state government fish-advisory Web sites. However, the researcher conducted exploratory analysis on these 47 cases to determine what factors may contribute to this decision.

Prior to beginning such an analysis, the researcher explored the possibility of valuing these respondents' answers with a zero, rather than removing them from the analysis. This approach did not appear valid because the remainder of the calculated knowledge score for these individual was artificially low. In essence, assigning a zero to some of their responses meant that these respondents answered the question incorrectly. However, these 47 respondents opted not to answer a portion of the questions measuring their knowledge by selecting that their knowledge was not affected by the site.

To verify this belief that these respondents would receive an artificially low knowledge score, the researcher conducted a cross tabulation to see whether those that selected “no change in views” in Survey Question 18 or 19 scored well on Survey Question 17, indicating that their knowledge score would otherwise not be low. For Question 18, 61% of those that selected “no change in views” scored a 4 (i.e., a perfect score) on Question 17. Another 32% scored a 3 (i.e., a high score) for Question 17. This means 93% of those that selected “no change in views” in Question 18 scored well on another question that was measuring knowledge. Similarly, for Question 19, 67% scored a 4 for Question 17 and 27% scored a 3. This shows that giving these individuals a zero in Questions 18 or 19 would be an inaccurate measure of their knowledge and would result in inaccurate conclusions for one’s knowledge of risks based on the site they viewed.

In order to investigate the factors that may contribute to this perspective, exploratory analysis was conducted on the individuals that selected “no change in views” in Question 18 or 19. Logistic regression was conducted on all 108 cases; the dependent variable, as shown in Table 23 below, was treated as dichotomous: those who stated that the Web site had an impact on their views (i.e., selected answer choice 18 a, b, or c) and those who stated that the Web site had no impact on their views (i.e., selected answer choice 18 d). The latter served as the reference category in the analysis. Because this analysis was exploratory, the researcher did not adhere to the parameters for sample size as defined by Cohen (1992); eleven independent variables were included, as opposed to eight.

Table 23. Effects of the Study's Independent Variable on Participants that Stated the Web Site Had No Impact on Their Knowledge in Survey Question 18 using Logistic Regression.

Variable	Model Results β (SE) [LB<Odds>UB]
Web site presentation format	1.34** (.51) [1.42<3.85>10.43]
Usability score	-.04 (.07) [.84<.96>1.10]
Credibility score	.18* (.11) [.97<1.19>1.48]
Ecological beliefs score	-.68** (.21) [.34<.51>.76]
Gender	-.83 (.72) [.11<.44>1.78]
Level of education	.71 (.48) [.80<2.03>5.19]
Political affiliation	1.10** (.53) [1.07<3.00>8.46]
Active fisherman/woman	.20 (.49) [.47<1.23>3.20]
Trust in non-profit information sources	.02 (.22) [.67<1.02>1.57]
Trust in private information sources	.42* (.24) [.96<1.52>2.42]
Score on Q17	.18 (.37) [.66<1.20>2.22]
Model Fit Statistics	
Number of observations	108
Cox & Snell R ²	.22
Nagelkerke R ²	.30
Hosmer and Lemeshow Test	12.06

*p < .10; **p < .05

Standardized beta values are reported for each variable with standard errors shown in parentheses. 90% CI for odds ratio are in brackets [Lower Bound<Odds Ratio>Upper Bound].

The model presented in Table 23 has a low R squared value and is not significant, showing that none of the independent variables evaluated in the model increase the predictability of the Web site having no impact on the respondent's views. However, five variables are significant. Whereas the overall model is not significant, the Web site presentation format ($B = 1.34$; $p = .01$), credibility score ($B = .18$; $p = .10$), ecological beliefs score ($B = -.68$; $p = .00$), political affiliation ($B = 1.10$; $p = .03$), and one's trust in private sources of information ($B = .42$; $p = .08$) are significant predictors of the probability of the Web site having no impact on the respondent's views. These findings show that the probability of the Web site having no impact on one's views increases for those respondents that viewed the California fish advisory Web site (as opposed to the Maryland site). The results show that, as a respondent's rating of a site's credibility increases, the probability of the site not having an impact also increases. This finding is surprising and does not seem intuitive. As a participant's ecological beliefs score decreases, the probability that the site has no impact increases. The probability of the site having no impact on one's views increases for those respondents that are non-liberal, in comparison to liberal respondents. Lastly, these findings show that, as a respondent's trust in private sources of information increases, the probability the site will not impact their views also increases.

The researcher conducted similar analysis on the respondents that selected "no change in views" on Survey Question 19. A logistic regression was conducted similar to the one outlined in Table 23; however, the results did not yield any significant findings. Neither

the model nor any of the independent variables showed significance. As a result, none of the independent variables that were assessed are significant predictors of the probability that a respondent would not experience a change in views on the basis of the Web site for Survey Question 19.

These findings show that a variety of factors may impact one's likelihood that the Web site they viewed would have little influence on their knowledge of the risks of fish consumption. These potential factors include the presence of graphical information (in the case of the California fish-advisory Web site), one's perception of credibility, ecological beliefs, political beliefs, and trust in private sources of information. Based on these findings, the researcher believes these individuals have strong pre-conceived beliefs about the environment, politics, and information produced by government sources that may make it difficult to convey environmental risks to this subset of respondents. These findings are exploratory, and it is possible that other factors that were not measured in this study may be contributing to the fact that the Web site did not impact the knowledge of risks of fish consumption for 47 respondents in this study. One other possible factor could include prior knowledge of this information.

The second dependent variable assessed in this study addresses the respondents' intent to change behavior and is addressed in the next section.

Linear Multiple Regression Addressing Participants' Intended Behavior Change

The respondents' behavior change score serve as the dependent variable in this portion of the analysis. The researcher ran a series of regressions, progressively adding to the number of independent variables to evaluate the relationship of each independent variable on the dependent variable, as shown in Table 24. Due to constraints with sample size, a maximum of eight variables is used in each model.

The researcher began this portion of the analysis using the ordinary least squares regression analysis method. Because the researcher had no assumptions on the preferred order for the entry of the independent variables in the regression model, the enter method was used. Assumptions for normality, linearity, and constant variance were tested using various plots of the residuals. The dependent variable met the assumptions for normality, linearity, and constant variance. Multicollinearity was measured using the tolerance and VIF values, which were not of concern. Therefore, the models assessing behavior change are conducted using linear multiple regression. The findings of the regressions are presented as three models in Table 24. Standardized beta values are reported for each variable with standard errors shown in parentheses. Model 1 considers three independent variables from this study; Model 2 considers the addition of control variables, and Model 3 incorporates interaction terms. Some of these variables were chosen for analysis on the basis of their significant correlations revealed through the correlation matrix.

Table 24. Effects of the Study's Independent Variables on Behavior Change Score Using Linear Multiple Regression

Variable	Model		
	1	2	3
Web site presentation format	-.27 (.36)	-.53* (.31)	-1.33** (.54)
Usability score	-.05 (.05)	.01 (.05)	.02 (.04)
Credibility score	-.02 (.07)	-.05 (.07)	-.07 (.07)
Ecological beliefs score		-.03 (.11)	-.05 (.11)
Age (in 2 groups)		.91** (.43)	.95** (.43)
Trust in information from private firm		-.29 (.13)	-.25* (.13)
Active fisherman woman			-.34 (.42)
Active fisherman woman x web site presentation format			1.17* (.67)
Model Fit Statistics			
Number of observations	64	61	61
R ²	.06	.19	.23
Adjusted R ²	.01	.09	.12
Model Improvement F Test	1.29	2.04*	1.99*

*p < .10; **p < .05

Standardized beta values are reported for each variable with standard errors shown in parentheses.

Model 1 does not result in any significant findings and also has a low R Square (.06). As the researcher evaluated the output of Model 1, it appeared there were three cases in the data that were outliers or influential cases. On the basis of the measures associated with DFFit (a measure of the influence of a case) and the covariance ratio (a measure of whether a case influences the variance of the parameters in a regression model), these three cases were removed from the analysis when proceeding to Model 2.

The independent variables listed in Model 2 in Table 24 explain a fairly small portion (19%) of the variation in the behavior change score ($R^2 = .19$); however this model is significant ($F = 2.04$; $p = .08$) indicating that the variables in this model increase the predictability of one's behavior change. The Web site presentation format ($B = -.53$; $p = .09$) and the respondent's age ($B = .91$; $p = .04$) are significant predictors of one's intended change in behavior in terms of fish consumption. These findings indicate that one's change in behavior decreases as a respondent views the California fish-advisory Web site, which is graphical in nature. Therefore, as one views the Maryland fish-advisory Web site, which is narrative in nature, a respondent's change in behavior increases.

These findings are consistent with those discovered by Yaros (2009b), which show that participants viewing graphically based online scientific news stories require a higher cognitive load. This higher cognitive load requires participants to spend a greater amount of time on these sites in order to process the message or information the site designers are trying to convey. These findings are also consistent with the recommended Web site design principles set forth in an editorial by *Smashing Magazine* (2008). This work shows that Web users are quick to search for alternatives when a site requires a higher cognitive load and is less intuitive in its navigation. This result supports Hypothesis 3 of this study and indicates that the narrative based presentation format, as compared to the graphical format, influences one's reported intention to consume fish.

The result of this analysis also shows that younger respondents (ages 20 to 39 years) show significantly higher behavior change score as compared to respondents in the older age category (ages 40 to 60+ years). These findings appear to be inconsistent with those reported by Hicks, Pivarnik, & McDermott (2008), who observed that older respondents (above the age of 45 years) are more likely to be frequent seafood eaters. Hicks, Pivarnik, & McDermott (2008) also reported findings that found significant increases in seafood consumption frequencies of those 45 years and older. Nonetheless, this result supports Hypothesis 5 of this study and indicates that one's social demographic influences, specifically one's age, impact one's reported intention to consume fish.

The independent variables in Model 3 explain a small, but slightly higher, portion (23%) of the variation in the behavior change score (R Square = .23); however this model is significant ($F = 1.99$; $p = .07$), indicating that the variables in this model increase the predictability of one's behavior change. As in Model 2, the Web site presentation format ($B = -1.33$; $p = .02$) and the respondent's age ($B = .95$; $p = .03$) are significant predictors of one's intended change in behavior in terms of fish consumption. Additionally, the respondent's view on trust of information from a private firm ($B = -.25$; $p = .07$) and the interaction variable between Web site presentation format and one's fishing status ($B = 1.17$; $p = .08$) are also significant predictors of one's intended change in behavior. These findings show that, as a respondent's trust in the information generated by a private firm increases, his or her behavior change score decreases. Conversely, as a respondent's trust

in information generated by a private firm decreases, his or her behavior change score increases.

As illustrated in Table 16, this study shows that respondents show a greater amount of trust in private firms as information sources, which is consistent with the findings reported by Rowan (2010). Rowan (2010) reports findings from a study conducted by Priest and colleagues in which the researchers found that, in the United States, there is greater trust in industry than in government and environmental groups in terms of biotechnology. This finding is also consistent with those reported by Hicks, Pivarnik, & McDermott (2008), in which the researchers observed that trust was low among their respondents in terms of the government's ability to ensure the safety of seafood. Despite the findings reported by Rowan (2010) and Hicks, Pivarnik, & McDermott (2008), the results of this study show that, as a respondent's trust in information generated by a private firm decreases, his or her behavior change score increases, leading the researcher to believe that public sources of information are more likely to affect one's behavior.

The final significant variable in Model 3 is the interaction variable between Web site presentation format and one's fishing status. This significant interaction variable illustrates that one's fishing status is influencing whether the Web site presentation format is influencing one's behavior change score. Essentially, those viewing the California site (graphical) have a lower behavior change score. However, if they do not actively fish or have a family member that actively fish, this behavior change score

increases. When active anglers view the graphical site, they tend to experience a lower behavior change score. Albeit a mediating influence, this finding supports Hypothesis 5 of this study and indicates that one's social demographic influences, specifically one's fishing status, impact one's reported intention to consume fish.

In Model 2, as shown in Table 24, the Web site presentation format is significant, whereas, this variable was not significant in Model 1. This could be due to the fact that additional variables were added to Model 2, and the presence of these new variables revealed outliers and influential cases that warranted removal from the analysis.

Removal of these cases may explain why a predictive relationship associated with Web site presentation format is detected in Model 2 and may not have been detected earlier.

Similarly, trust in private sources of information shows a predictive relationship in Model 3 that was not detected in Model 2. To investigate this phenomenon, the researcher consulted the correlation matrix to check whether this variable was correlated with some of the other variables in Model 3 but found no such relationship. It is possible that some other variable unaccounted for in this study may influence behavior change and may also be correlated with trust in private sources of information or with one of the additional variables added to Model 3. Such a phenomenon may account for the ability for Model 3 to detect a predictive relationship among behavior change and trust in private information sources that was not detectable in Model 2.

The total sample for the regression consisted of 64 participants. In total, 44 participants in the study (out of a total of 108) were removed from this portion of the analysis because one of the questions measuring intent to change behavior was improperly coded by the researcher in the survey development phase. Due to this oversight, it was not possible to know whether certain respondents would have selected an answer choice indicating that they would never recommend the consumption of fish to others on the basis of the Web site they viewed or whether they simply tend not to make such recommendations. Therefore, the cases associated with this error were removed and coded as missing values.

To determine whether the addition of these cases would impact the results of this portion of the analysis, additional analyses were explored. The researcher coded these responses to indicate that the respondents would never recommend the consumption of fish to others on the basis of the Web site they viewed and added these cases into the analysis addressed in Table 24 above using the full sample ($n = 108$). The outcomes showed no differences from those illustrated in Table 24, with the exception of slight changes in the value of the beta coefficients. Otherwise, the beta coefficients maintained the same directions, and none of the significance levels changed.

The next section addresses additional exploratory analysis on the influence of the Web site presentation format on various components of usability and credibility.

Linear Multiple Regression Addressing the Components of Usability and Credibility

Additional exploratory analysis of the data prompted the researcher to evaluate whether a site's presentation format was influential in predicting any individual component or element of usability or credibility. Using a linear multiple regression model, the Web site presentation format was treated as the independent variable, whereas each survey question assessing usability was treated as a dependent variable. The results of this analysis show that a narrative presentation format is a strong predictor of usability when considering the use of consistent terminology throughout a site ($B = .45$; $p = .02$).

When treating the Web site presentation format as the independent variable and each survey question assessing credibility as the dependent variable, results show an additional relationship. A Web site's presentation format, specifically a narrative approach, is a strong predictor of credibility when considering the use of consistent information about contaminants throughout a site ($B = .19$; $p = .09$).

On the basis of the findings of this exploratory analysis, it appears that the narrative site (Maryland) shows a greater degree of usability and credibility when considering consistent terminology and consistent information about contaminants throughout the site.

Evaluating the Conceptual Framework and Hypotheses Testing

This study's research question, supported by the conceptual framework reprinted for reference in Figure 4 (shown below), posits that a Web site's usability, credibility, and presentation format are influential in increasing consumers' knowledge of risks and in affecting their reported intention to change behavior when consuming fish and choosing fish options for their families. Is this supported?

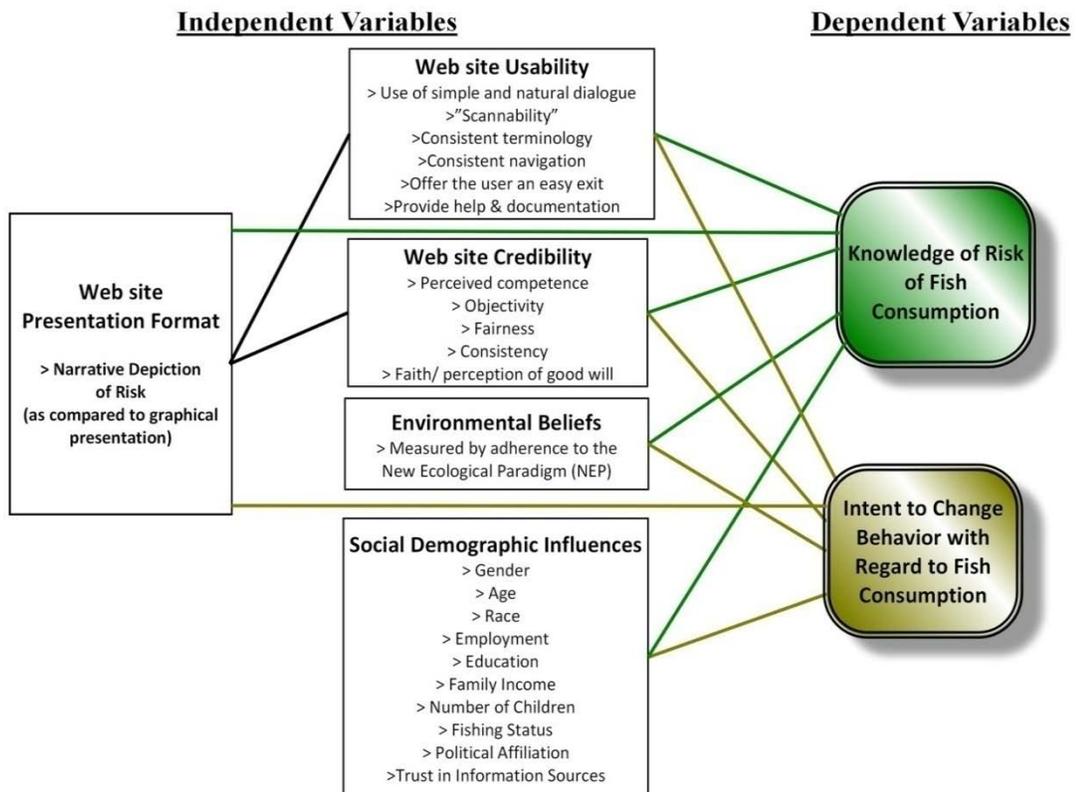


Figure 4. Conceptual Framework for Research Study (Reprinted)

The results of this study do not show that usability and credibility as measured are significantly influencing one's knowledge of the risks of fish consumption or intended behavior change. However, the results of this study show that other factors are significant predictors of one's intended behavior change when choosing and consuming fish. A Web site presented in a narrative format (as opposed to a graphical presentation) is a significant predictor of an intended change in behavior. The conceptual framework for this study suggests that the presentation format influences a user's intended behavior change and knowledge through their perceived usability. The results of this study show that this is not the case. Instead, there is a direct relationship between a site's presentation format and a user's intended behavior change, and they are not influenced by usability.

One's age, trust in private sources of information, and fishing status along with the site's presentation format are also significant predictors of intended behavior change. In this study, younger parents between the ages of 20 and 39 years were more likely to report an intended change in their behavior. The results show that one's age impacts the effectiveness of risk communication about contaminants in fish and can predict his or her propensity to change behavior with regard to fish consumption. As such, this result supports Hypothesis 5 of this study and indicates that one's social demographic influences, specifically one's age, impact one's reported intention to consume fish.

The study's findings show that, as a respondent's trust in the information generated by a private firm increases, his or her behavior change score decreases. In other words, the results of this study show that, as a respondent's trust in information generated by a private firm decreases, his or her behavior change score increases, leading the researcher to believe that public sources of information are more likely to affect one's behavior, further supporting Hypothesis 5.

Additionally, the interaction of one's fishing status with the type of site being viewed influences one's behavior change score. Respondents viewing the graphical site have a lower behavior change score; however, if they do not actively fish or have a family member that actively fish, this behavior change score increases. When active anglers view the graphical site, they tend to experience a lower behavior change score, indicating that a narrative site may resonate more with active anglers or their family members. Albeit a mediating influence, this finding supports Hypothesis 5 of this study and indicates that one's social demographic influences, specifically one's fishing status, impact one's reported intention to consume fish.

In terms of knowledge, one's ecological beliefs and gender are significant predictors of a perfect knowledge score. This shows that respondents with higher levels of ecological beliefs or environmental consciousness tend to score a perfect score in terms of knowledge of the safety of fish consumption. This result supports Hypothesis 4 of this study and indicates that one's attitude about environmental concerns, as measured by the

NEP, positively influences the effectiveness in communicating knowledge about the health risks related to fish consumption.

Additionally, male respondents tend to score a perfect knowledge score in terms of the safety of fish consumption, as compared to females. The results of the analysis in this study support Hypothesis 5 and indicate that certain social demographic influences impact the effectiveness in communicating knowledge about the health risks related to fish consumption.

On the basis of the results of this study, there appears to be a relationship between a Web site's presentation format and certain elements of usability and credibility. It appears the narrative site (Maryland) shows a greater degree of usability and credibility when considering consistent terminology and consistent information about contaminants throughout the site.

Broadly, this study investigates whether a highly *credible* and *usable* Web site is most effective in communicating environmental risks and whether or not this is influenced by a site's *presentation format*. It is this study's assumption that a site's credibility, usability, and presentation format will influence the user's knowledge of environmental risks and can spur change in the behavior of the consumer of environmental risk information. The results outlined in this chapter partially support this study's assumption and allow the

researcher to accept Hypothesis 5 and partially accept Hypotheses 3 and 4, as discussed below.

H.1. The perceived usability of a Web site will influence its effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

Despite the importance of a usable Web site in effectively communicating environmental risks, as addressed in the literature, the researcher does not discover findings that prove this hypothesis. The results show that a Web's sites usability, as measured by respondents of the survey in this study, has little explanatory power when considering knowledge about the health risks and benefits related to fish consumption (see Table 22). Similarly, usability has little explanatory power when considering the respondents' reported intentions to consume or recommend the consumption of fish and seafood (see Table 24).

H.2. The perceived credibility of a Web site will influence its effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

The credibility of Web sites, as discussed in Chapter 2, has been shown to influence one's perception of environmental risks. Despite these findings, the outcomes of this

study do not prove this hypothesis. The results show that a Web's sites credibility, as measured by respondents of the survey in this study, has little explanatory power when considering knowledge about the health risks and benefits related to fish consumption (see Table 22). Similarly, credibility has little explanatory power when considering the respondents' reported intentions to consume or recommend the consumption of fish and seafood (see Table 24).

H.3. The narrative-based presentation format will have a greater influence on effectiveness than the graphical format in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

The findings of this study show that the presentation format of a Web site does not influence the effectiveness in communicating knowledge about the health risks related to fish consumption. However, the narrative-based presentation format of a Web site communicating safe fish-consumption information has a greater influence on the reported intention to consume or recommend the consumption of fish and seafood. As a result of these findings, the researcher partially accepts this hypothesis.

H.4. One's attitude about environmental concerns, as measured by the NEP, will positively influence the effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

The results of this study show that the respondents' environmental beliefs had little explanatory power on their reported intention to consume or recommend the consumption of fish and seafood. In terms of knowledge about the health risks and benefits related to fish consumption, one's ecological beliefs are a significant predictor of achieving a perfect knowledge score. Respondents with a greater level of ecological beliefs or environmental consciousness tend to score a perfect score in terms of knowledge of the safety of fish consumption. Therefore, the researcher partially accepts this hypothesis.

H.5. One's social demographic influences will impact the effectiveness in communicating knowledge about the health risks related to fish consumption and the reported intention to consume fish.

The final factor that was considered for hypothesis testing in this study considered one's social demographic influences, including his or her gender, age, race, employment status, education level, family income, number of children, fishing status, political affiliation, and trust in information sources. The results of this study show that one's age impacts the effectiveness of risk communication about contaminants in fish and can predict his or her propensity to change behavior with regard to fish consumption. The results also show that male respondents tend to score a perfect knowledge score in terms of the safety of fish consumption, as compared to females. As a result of these findings, the researcher accepts this hypothesis.

Many of the negative findings above may be attributable to a variety of factors. The reliability analysis of the independent variables of usability and credibility showed a relatively high degree of reliability of these measures. However, both Web sites in this study ranked very low in terms of these measures. Had these rankings by the respondents been higher, the results may have shown a greater influence of these variables.

Additionally, conducting a reliability analysis on the dependent variables in this study was not possible because the questions used to generate the knowledge score and behavior change score were measured on varying scales. Perhaps the measurement of these dependent variables was not strong enough to detect an accurate measure of change.

Another possible explanation for the lack of positive findings may be due to the fact that the sample size for this study was relatively small and homogeneous and that, in some cases, the data were constrained. These limitations may have made it difficult to detect certain trends in the data that may have otherwise resulted in significant findings.

Conclusions

A large portion of the respondents in this study felt that the Web sites they viewed conveying information on safe fish consumption do not change their knowledge on this issue. However, the analyses show that one's ecological beliefs and gender are significant predictors of knowledge gained from Web sites conveying safe fish-consumption information.

Although the intended behavior change with regard to fish consumption among them is low, the respondents exhibit a strong interest in seeking more information on this issue. Participants also show that they are more likely to trust information on safe fish consumption from private sources, as opposed to non-profit or government sources. Findings from the analysis show that a Web site's presentation format, the respondent's age, his or her trust in private sources of information, and fishing status coupled with a site's presentation format are significant predictors of one's intended change in behavior in terms of fish consumption.

One important finding from this study shows that, among the target population of parents with young children in Maryland, both the usability and the credibility of Maryland and California's state fish-advisory Web sites ranked very low. On the basis of the analysis presented in this chapter, robust scales to measure and evaluate usability and credibility have been created. These scales may serve as useful measures of these factors when evaluating approaches to present information on safe fish consumption and other environmental risks. This may prove especially useful should existing sites be redesigned in order to improve their usability and credibility.

The researcher identified the aforementioned elements as the focus of this study on basis of the importance of these issues as addressed in the literature. As the next chapter will show, these factors were also selected from a practical perspective. Considerations of the

usability and credibility of one's site are addressed by a subset of state representatives in Chapter 5.

CHAPTER 5: STATE INTERVIEW RESULTS AND ANALYSIS

The purpose of this study is to develop recommendations to assist government organizations in planning and evaluating environmental-risk information, educational materials, and other risk-communication efforts related to fish contamination delivered through the Web. The previous chapter outlined the quantitative portion of this study: results of a survey of parents with young children from the state of Maryland. These outcomes show respondents' preferences about Web site usability, credibility, and presentation format and how these factors are influenced by their environmental beliefs and demographic characterizations. These results provide rich, comprehensive descriptions of the impacts of these factors on the respondents' knowledge of risks and their intentions to change their behavior when consuming fish.

To develop meaningful recommendations, the perspective of the risk communicator is also considered in this study. The use of multiple data-gathering techniques to investigate the same phenomenon provides a richer data set (Berg, 2007; Druckman, 2005) that delivers a robust view of the issue from the eyes of the survey respondents as well as the communicators. This technique, known as triangulation, allows for the use of

multiple lines of sight. By evaluating multiple perspectives, this research obtains a better, more substantive picture of reality (Berg, 2007).

In this case, the communicator consists of state government organizations that develop and post online fish-consumption advisories. The researcher interviewed representatives from a subset of these organizations to determine whether they believe usability and credibility are influential factors when they design their Web sites and whether these factors aid effective communication about environmental risks.

To gather these perspectives, eight phone interviews were conducted from November 2010 to January 2011 with various state representatives responsible for posting advisories. The participants for this qualitative portion of the study are listed in Table 19. Each participant listed in Table 19 agreed to serve as an interviewee in this study and have their perspectives included in this research.

Nine questions, as listed in Appendix 3, were asked in each interview to provide structure and lend consistency to these discussions. State representatives from California, Idaho, Louisiana, Maine, Maryland, New Jersey, Pennsylvania, and South Dakota were asked about their role in issuing fish-contamination advisories on the Web and whether alternate forms of communication are used by their organizations (such as brochures, posters, etc.). Interviewees were also asked what specific protocols they follow to employ components of usability and credibility on their sites. The specific protocols that

were addressed in the questions included their use of simple language and considerations of the site's scannability, consistent terminology, and navigation, as well as the ability for their users to find their way back to previous information, to ask questions, and submit comments, and whether they find these questions/comments useful. Additional questions addressed whether they provide objective information and represent all relevant points of view and how they do so. The researcher also asked about the amount of traffic their sites generate as well as the design method and presentation format they chose for their site and the factors that influenced this decision. Participants were also asked whether they have considered usability testing of their site by users.

Table 25. State Representatives/Participants in State Interviews

Study Participant/Title/Organization
Thomas Barron Standards Section Chief Pennsylvania Department of Environmental Protection
Robert Brodberg, Ph.D. Fish and Water Quality Evaluation Section Chief California Environmental Protection Agency
Eric Frohmberg Toxicologist Maine Center for Disease Control and Prevention
John Hill Environmental Specialist Maryland Department of the Environment
Adrienne Katner Environmental Health Scientist Louisiana Department of Health and Hospitals
Shannon Minerich Environmental Program Scientist South Dakota Department of Environment and Natural Resources (DENR)
Terri Tucker Administrative Analyst New Jersey Department of Environmental Protection
Jim Vannoy Program Manager Idaho Department of Health and Welfare

Through these questions and conversations, the interviewees shared their perspectives on the challenges they face when trying to communicate their message effectively and how they perceive the usability and credibility of their own sites, which are addressed below. This chapter also compares these perspectives to those of the respondents to the survey discussed in Chapter 4.

States' Perspectives on Usability and Credibility as compared to Survey Findings

As presented in Chapter 4, the respondents to the survey in this study rank both the usability and credibility of the California and Maryland state fish-advisory Web sites very low.

In terms of usability, the results of the survey show low usability scores for both Web sites, as shown in Table 16 in Chapter 4. On a scale of 5 to 35, the mean usability score for the Maryland fish-advisory Web site, as given by respondents, is 12.92. The mean usability score for California's site is 13. These scores show that there is room for improvement in terms of the sites' ease of use, use of simple and natural language, scannability of the content, use of consistent terminology and navigation, ability to allow the user to go back to an earlier page, and the ability for the user to obtain help with the site or ask questions.

Similarly, the overall credibility score given by respondents to the survey, as shown in Table 16 of Chapter 4, is low. On a scale of 5 to 25, respondents rank the credibility of Maryland's site at 9.26 and California's fish-advisory site at 8.67. These scores show that there is room for improvement in terms of the sites' perceived competence, objectivity, fairness, consistency, and perception of good will.

Based on the interviews with state representatives, it is clear that state government organizations also believe that enhancing the usability and credibility of their sites will

help their users better understand steps they can take to safely consume fish. The following sections illuminate the aspects of usability and credibility state representatives feel are important to consider when delivering their message.

Usability

Some of the states in this study spend a portion of their budgets on developing, printing, and distributing print materials such as brochures, fishing guideline booklets, and fact sheets in order to reach their citizens in multiple ways. Although state communicators are turning their attention to their Web sites, many of them are spending a good deal of effort on their print materials. However, some states are finding this process onerous and expensive and are devoting more attention to their Web sites.

Nearly all of the interviewees view the Web as a medium to reach many people in a relatively inexpensive way. These interviewees point out they are often thinking about ways in which their information can be presented in a clearer, more consistent way without excess clutter. There are a number of steps that states have incorporated into their approaches to enhance the usability of their sites.

In many cases, states often develop standard language for their advisories. This often contains a short standard statement of the benefits of fish consumption and addresses standard elements to minimize one's risks such as recommended meal size, meal frequency and testing procedures. This language is incorporated into their advisories and

on other pages on their Web sites. Ultimately, this approach means that users can expect to see consistent terminology and navigation from page to page. This also makes the process of posting introductory information less resource intensive.

The interviewees expressed a desire to harness the use of simple and natural language on their sites. These authors are also extremely concerned about the use of “technical jargon” and work hard to minimize it. Many states feel the need to write their material at a low-literacy level, at or below the eighth grade reading level, because many Americans (roughly 40 percent) read at a “below basic” or “basic” literacy level (U.S. Department of Education, 2007). California’s Dr. Brodberg explained, “When we draft our text, we really try to bring things down to the eighth to eleventh grade levels, especially in our executive summaries. We get frustrated, though, because we aren’t trained communication professionals, and we try to learn as we go.”

Most of the interviewed state representatives recognize the value in providing an email and/or phone contact point on their sites. Often, incoming questions are filtered by one person and sent to the appropriate state contact. Requests are of a small amount (approximately three to five emails or phone calls per month) and usually increase slightly over the fishing season. Some interviewees see these comments as an opportunity to better understand what their users are looking for and what content they find most useful; however, many said these comments are not often illuminating.

None of the state representatives interviewed in this study conduct usability testing on their sites. However, some states have reached out to their users to conduct focus groups on their print materials or to gain insight on their audience. “We’d really like to [consider usability], but it’s really going to come down to resources. It’s not likely based on today’s resources,” explains Mr. Hill from Maryland, “but we’ll be really interested in your results of your survey.”

Dr. Brodberg shared his constraints in working within the template they are required to use:

“Like other government Web sites, the [California] site is a government site and there are rules of presentation that we have to deal with. We have other things linked off of the site, like the governor’s information, and items linked of the right-hand side and tabs across the top. This format is a required template and it’s not necessarily related to fish information in particular.”

He also expressed a desire to improve the presentation of information on their site. “Our director, who is new, is pushing us to use more bullets, to have more white space and clearer presentation of text. We ultimately want to get across our key points in some sort of summary format, which I don’t think we do very well right now.” He added, “Essentially, communication is a third arm in the Office of Environmental Health Hazard Assessment (OEHHA) and doesn’t have a lot of resources—we have one press person, but no other communication or public participation specialists.”

Interestingly, both of these points were raised by some of the survey respondents when answering the open-ended question provided in the survey. Respondents to the survey addressed in Chapter 4 were asked what they found difficult or easy to use about the site they viewed. In response to that question, one respondent commented that there was too much extraneous information and links not related to the safe consumption of fish. They added, “I would not use this site for information about fish since it’s a small part of the overall site. It is a bit overwhelming with all the California links to the top and left. It would be nice to have some of that hidden while on the “fish tab.”

Another respondent to the survey commented on their desire to see an improvement in the presentation of the information on the California fish advisory site. “I found the layout difficult to scan—too many pages that are too long, too much dense type, and not enough white space. The navigation is also cluttered and busy. This makes it distracting and adds to the sense of information overload.”

The state representatives also consider the credibility of their site and recognize this is an important factor when trying to get their audience to consider state recommendations and elicit a change in consumers’ behaviors.

Credibility

State's risk assessors, researchers, and producers of the sites take their content, recommendations, and guidelines very seriously. Not only are the accuracy of their information and competence of the source impacting on the public's health, but the guidelines also have an effect on the local fishing industry. In fact, the majority of a state's resources for this issue are spent on determining when to issue an advisory. All of the states in the study focus on whether or not their detected levels of contaminants are at or above the action level issued by the Food and Drug Administration (FDA), as discussed in Chapter 1, which triggers when it is appropriate to issue an advisory. Because states are so focused on the validity of their recommendations, often communication of these advisories is an afterthought.

Pennsylvania's Mr. Barron spoke highly of his state's testing procedures. "Overall we are sampling with a lot more frequency and becoming more aware of the contaminants and issues surrounding them. Our processes keep getting better over time." However, Mr. Barron admits their challenges in communicating clearly. He says:

"Our technical workgroup has really tried to focus on [improving] aspects of our site, but we're all scientists, and, as a result, things get very technical and wordy. To improve the communication and the messaging, we had formed an ad hoc workgroup to focus on communication, but this workgroup has been inactive for a while."

Presenting a balanced message is a real challenge for states and can impact their perceived competence and objectivity, both of which can impact their credibility.

The state representatives acknowledge that providing fair and objective information lends to their site's credibility and as a result is a major focus of nearly all of the state representatives interviewed in this study.

Many states recognize the need to present a balanced message and limit their use of technical jargon while still conveying their technical expertise on the issue. In essence, consumers are confronted with a dilemma: they are told that seafood is good for them and should be consumed regularly, while at the same time the federal government and virtually all the state governments have issued advisories urging caution in consumption of fish of certain species or from specific waters (Institute of Medicine of the National Academies, 2006). Due to this dilemma, there is a great deal of focus on a balanced message by the states. Mr. Vannoy from Idaho explains:

“There are a lot of benefits [to eating fish] and we work really hard to not scare people off from eating fish. We have danced around this issue quite a bit [in our state]. Unfortunately, we just don't know how our information is being perceived and haven't had the time or money to look at this.”

Most of the states interviewed have a multi agency structure or committee for the management of their advisories. The fish-consumption advisory process in many states is managed by a number of departments, usually three state agencies, each with a different

focus (such as environment, public health, and fish and game). Often, but not always, one group is responsible for sampling, another for analysis, and another for posting the findings and creating the advisories. This makes creating a credible, coherent Web site a true challenge.

In some cases, this struck the users of these sites, too. When answering the open-ended question provided in the survey, one respondent who had viewed the Maryland site indicated:

“You can tell there are many groups/agencies working “together” here and so it comes across less organized. While I didn’t notice any discrepancies, probably because I’m a little frustrated navigating around, this collection of information leads me to think there is a serious likelihood that discrepancies are present. While I think that there is a lot of information here, it is difficult to navigate unless you simply click the back button to get back to where you started. I would be interested in coming back to this site for further research but I do find it a little frustrating and that might prevent me from doing so.”

Another respondent to the survey who had viewed the Maryland site had a similar comment:

“[The site] does seem to aggregate information from several other agencies/sources and link to them for reference, which seems to me to make it a little harder to use and less focused or edited to create a simple overview. But the

subject itself is broad enough that I can see how it would be hard to make it an accurate summary that could also be called “simple.”

The state representatives were also asked about the presentation format they felt was most popular on their sites and what their preference was in selecting a graphical interface or a narrative one.

Web Site Presentation Format

The majority of the states in this study have developed sites that are narrative in nature. Most of them have developed pages with a few graphics (such as pictures of fish or a map) and make a large number of links available. These links usually point to detailed information about safe fish-consumption guidelines or are files containing actual advisories on specific lakes or water bodies within their state. This characterization may not be representative of all state fish-advisory Web sites, but most of the state representatives in this study have opted to post their information in this format. Many of them feel their sites are cheaper to develop or easier to maintain without many graphics.

A few of the states in this study use graphics on their sites in key ways. Maryland’s John Hill highlighted the benefits of using a graphical format when presenting certain types of information:

“We like to use graphics whenever it helps communicate our message. For example, we use a graphic of a cross-section of a fish (as shown in Figure 5

below), which I've seen on other state's advisories, too. This really helps illustrate the parts of the fish that you just can't do using text. A picture is worth thousand words here; you just can't describe in text."



Figure 5. Graphic of Cross-Section of Fish from Maryland's Advisory Site (obtained from: http://www.mde.state.md.us/programs/Marylander/CitizensInfoCenterHome/Pages/citizeninfocenter/fishandshellfish/protect_health/index.aspx)

Both California's and Idaho's sites display a mercury meter (as shown in Figure 6 below) under their "Safe Eating Guidelines for Women and Children." Mr. Vannoy from Idaho explains, "This is similar to the speedometer for your car, and I think it's really intuitive and people like this. Actually, we use this for both commercial fish and local fish, since the majority of people are consuming commercial fish."

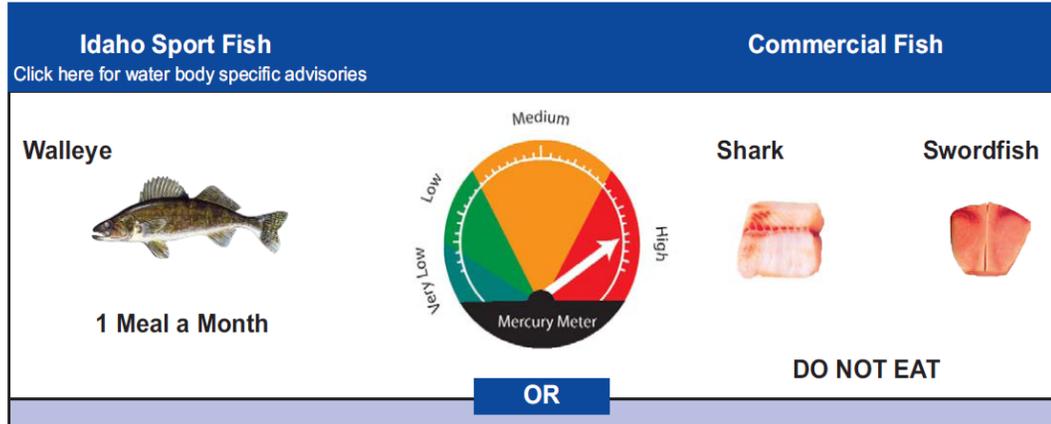


Figure 6. Mercury Meter Posted on Idaho's Advisory Site
(obtained from:

<http://www.healthandwelfare.idaho.gov/LinkClick.aspx?fileticket=QJvF7dRQ2Zs%3d&tabid=180>)

The information gathered from the interviews showed that all of the state representatives in this study felt it was important that they present their information in a usable way and position their sites to be credible. There is a great deal of consistency among the states in this study in the way they strive to improve their site's usability and credibility and in the way they present their information.

State Representative Interview Findings

These interviews show that many state representatives feel developing a usable and credible site will enhance their message and allow them to more effectively communicate with their users through their Web sites. However, these interviews also show that states struggle with their ability to produce and maintain sites that they feel are usable and credible.

Although the results of the survey in Chapter 4 are not generalizable to a broader population, they show that a subset of users also feel the credibility and usability of Maryland and California's fish-advisory Web sites are not adequate. Essentially, the state representatives and the target population they are intending to reach are both expressing concerns relative to these attributes, therefore validating the experimental findings.

The results of this study show shortcomings in the credibility of these sites from the perspectives of the communicator and the survey respondents. State representatives expressed the challenge they face in presenting a balanced message and maintaining consistent information on their sites with input from multiple organizations across their state. Similarly, the respondents to the survey, as shown in Chapter 4, indicate Maryland and California's fish-advisory Web sites had low credibility in terms of the perceived competence of the sites, the objectivity, fairness, consistency of the content, and the perception of good will that is exuded by the site.

As Fogg et al. (2001) point out, when users evaluate credibility, a person makes an assessment of both the trustworthiness and expertise of a site to arrive at an overall credibility assessment. State representatives recognize the importance of this assessment and work diligently to present a balanced message on fish consumption. This is consistent with Bostrom and Lofstedt's (2003) findings that show risk managers remain

concerned about declining public trust because it erodes the efficiency of the risk management process.

State representatives also experience challenges in maintaining usable Web sites. The focus of state communicators on particular aspects of usability is consistent with the components of usability needed for an effective Web site design as observed by Nielsen (1994) and Yaros (2009a). The interviewees in this study strive to express issues surrounding fish-consumption advisories in clear, simple, understandable terms. They also are cognizant of providing consistent terminology and navigation, making their sites scannable, and providing users the opportunity to ask questions or submit comments, but they see room for improvement in many of these areas.

Similarly, the respondents to the survey, as shown in Chapter 4, indicated that Maryland and California's fish-advisory Web sites had low usability in terms of their Web site's ease of use, use of simple and natural language, scannability of the content, use of consistent terminology and navigation and the ability to provide the user with an easy exit, and provide the opportunity for help.

The open-ended responses in the survey described in Chapter 4 revealed that many users of both sites were frustrated with the navigation. They expressed the difficulty of returning to the homepage or guidelines and felt they needed to rely on the back button in their browser to find the information they were looking for.

Some states, such as Maine, have taken extensive measures to learn what terms their users understand and do not understand. They have held focus groups with their residents and have learned that their users understand the terms “omega-3” and “mercury” but struggle to understand what is meant by “PCBs” and “dioxin.” In some cases this familiarity may be attributable to other sources of information, where users often hear the former terms in media sources and have become accustomed to them. The developers of Maine’s site take these factors into consideration when creating text for their site and print materials to ensure the language they are using is simple and natural.

State communicators also conveyed their preference in selecting a Web site presentation format. Most interviewees display their contact in a narrative site with links to specific advisories across their state. This is consistent with the preference expressed by the survey respondents, as addressed in Chapter 4. In the survey, the narrative presentation employed by the Maryland state fish-advisory Web site is a significant predictor of intended behavior change, as compared to the graphical presentation of the California site. In a study conducted by Yaros (2009b), he found that the presence of graphics resulted in a higher cognitive load by users, which prompted the author to recommend judicious use of graphics in Web sites. State communicators appear to be applying this principle on their sites.

Conclusions

Through these conversations, it became apparent to the researcher that many of the state communicators do not appear to have a great deal of confidence in their sites in terms of their usability and credibility. It is not the case for all of the states in this study, but some groups recognize room for improvement. As mentioned above, no state in the study is conducting usability testing; however, some informal surveys of local populations are occurring. Despite the lack of formal testing, there does seem to be a strong desire to improve one's messages.

Addressing the deficiencies identified by the respondents will likely be a challenge for states, given their resource constraints. During the interviews, it became apparent that resources are a defining factor for many of the interviewees. Managing the advisories is usually one of many tasks of the state representative's job. Some states have no funding for this effort, and most of the states in the study didn't feel they were adequately funded or had the time, skills, or resources to conduct tests to evaluate their material (either in print or on the Web).

During the interview, John Hill of Maryland outlined his responsibilities related to fish-consumption advisories. "I work with the field crew, I oversee the lab work and results, I get the data and run the calculations (body weights, exposures, time calculations, etc.). I also create the new PDF, which contains the amount of fish that can be consumed that we

post online.” He added, “We have a small team working on this issue, and fish advisories are not my only task/duty.”

These interviews also revealed that state communicators responsible for educating their citizens on safe fish consumption are members of a larger community dealing with this issue across the country. Many of these individuals and teams have attended forums similar to the National Forum on Contaminants in Fish, mentioned in Chapter 2, in order to learn from others about the approaches that are most effective in communicating their message. These interactions appear to be an ideal way for states to leverage their resources and learn from each other.

These state fish-advisory Web site, albeit not known by every citizen, reach a number of individuals across the country. Many of the states interviewed received thousands of hits per year, with some sites receiving many more.⁶ Consideration of improvements to these sites would ultimately enhance the information that is available and support consumers’ fish and seafood consumption decisions.

⁶ Maryland, California, New Jersey, and Maine are on the higher end of hits received. Maryland averages about 2,500 hits a month. California sees an average of 836 hits per month. New Jersey receives an average of 960 hits per month. Maine is off the charts, with over 9,000 hits per month.

Idaho and South Dakota received fewer hits. Idaho receives about 170 hits per month and South Dakota receives an average of 130 hits per month. Pennsylvania and Louisiana do not currently track the number of hits to their site.

CHAPTER 6: CONCLUSIONS

Information technology has altered our lives, whether for work, study, or leisure. It is so ubiquitous that we rarely stop to think about how we interact with it. Access to information is something we expect and take for granted as a modernized society. This study takes a step back and focuses on what aspects need improving for Web sites to better convey environmental risks.

The Institute of Medicine of the National Academies formed a Committee on Nutrient Relationships in Seafood in order to address the risk/benefit balance in fish and seafood consumption. The Committee's report, issued in 2006, acknowledges that advice to consumers on fish and seafood choices to promote human health from the federal and state governments has been fragmented (Institute of Medicine of the National Academies, 2006). They suggest that public administrators should develop tools for consumers, such as computer-based, interactive decision-support tools and visual representations of benefits and risks that are easy to use and to interpret. The Committee also suggests that we need research to develop and evaluate communication tools that are more effective in conveying the health benefits and risks of fish and seafood consumption, as well as to promote current and emerging information to the public, such as new advisories.

To improve the whole of societal learning, as suggested by Kirilin (1996), actively engaging the public in information acquisition is an important challenge for governments. Administrators of state-run Web sites used to convey information on environmental risks need to continually evaluate their sites' effectiveness to help ensure that they affect the desired behavior change in targeted audiences. The Web has become an important mechanism for obtaining information and, coupled with a consumer's will to learn, can help them move beyond a situation of helplessness when faced with an environmental risk, such as decisions on consuming fish and choosing fish options for one's family.

This study uses survey data and qualitative findings to fill a void in current research and to focus on identifying actions that we can take to improve messages that state government Web sites distribute. This study shows that respondents rank the usability and credibility of the Maryland and California state fish-advisory Web sites very low. In addition, a large portion of the survey respondents felt that the information conveyed on state-run Web sites has no impact on their knowledge or behavior regarding safe fish consumption. Respondents did, however, indicate that they wanted to learn more about steps they can take to ensure that their children and families are eating safe fish and seafood, and they exhibited a strong desire to seek more information on this issue.

Analysis was conducted on the portion of respondents who indicated that these Web sites will impact their knowledge or affect their behavior. This analysis shows that respondents' ecological beliefs and gender are significant predictors of high knowledge

scores. These findings are depicted in the conceptual framework shown in Figure 7.

From a risk-communication perspective, these findings comport with the Social Amplification of Risk Framework developed by Kasperson et al. (1988). This framework illustrates that social, psychological, and cultural factors can either amplify or attenuate the perception of harm. This study shows that one's gender or attitudes toward the environment may be amplifying or attenuating perceptions of hazard associated with fish consumption.

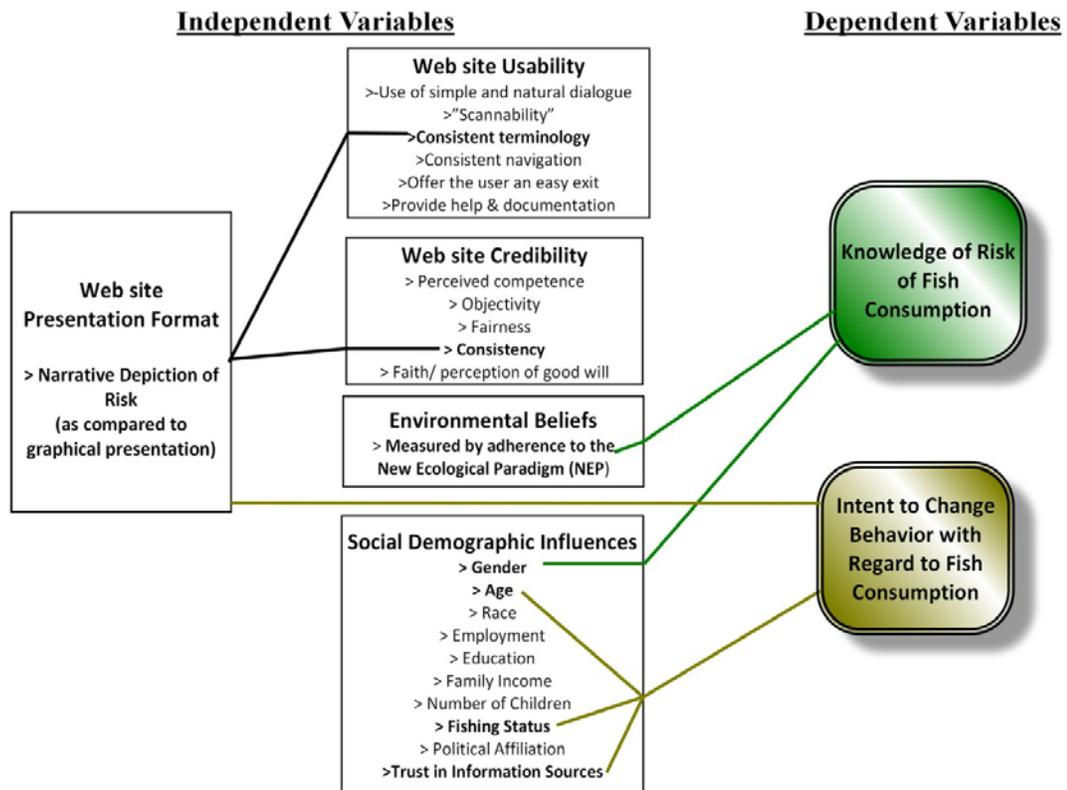


Figure 7. Conceptual Framework for Research Study Depicting Actual Relationships as Measured

The findings of this study also show that the format in which a risk is presented on a Web site is a significant predictor of a respondent's intended change in behavior. A narrative presentation, as opposed to a graphical one, can influence respondent's intentions in changing their behavior. Younger respondents (between the ages of 20 and 39 years) also show a greater propensity to change their fish consumption behavior on the basis of information they learned from state-run fish-advisory Web sites. One's intended behavior change can also be influenced by the respondent's trust in private sources of information. As a respondent's trust in the information generated by a private firm decreases, their intentions to change behavior increases. Additionally, when active anglers view a graphically presented fish-advisory Web site, they tend to report less of an intention to change their behavior in terms of fish consumption. This indicates that a narrative site may resonate more with respondents who are active anglers. These findings support the fact that Web site presentation format, respondent's age, trust in private sources of information, and the presentation format mediated by the respondent's status as an angler may be amplifying or attenuating perceptions of hazard associated with fish consumption. These results also partially support the conceptual framework that illustrates the impact of these factors on one's knowledge of risk and intention to change behavior.

State communicators responsible for posting this information have exhibited a strong desire to improve their Web sites to make them more usable and credible to better ensure that their messages are communicated clearly, accurately, and effectively. In doing so,

communicators have a better chance of changing the desired behavior. These communicators want citizens to choose wisely and eat fish that are high in omega-3 fatty acids and low in contaminants such as mercury, polychlorinated biphenyls (PCBs) and dioxins. Eliciting this behavior change will likely require communicators to present usable and credible messages and consider other factors such as the audience dynamics (such as age, whether they actively fish, their beliefs about the environment, and their trust in the source of the information).

We can improve the process of social learning by introducing citizens to Web sites that employ best practices for usability and disseminate credible information. Making sites more usable; enhancing them to convey clear, concise messages; and taking steps to appear more credible all help to ensure that information is communicated, received and acted on by the intended audiences. State communicators are responsible for a portion of the actions needed to meet these goals, but they are often underfunded and in need of support to better safeguard consumer health.

The state representatives that were interviewed in this study expressed their sensitivity to the negative tone of their message and recognize that often citizens will stop consuming fish altogether as a result. This is not the desired outcome, according to many of the state representatives. Instead, these communicators want citizens to choose wisely and eat fish that are low in contaminants such as mercury, PCBs and dioxin. Maine's Eric Frohberg explains, "in our communications, we wanted to stay away from negative behavior and

focus on positive behavior of what people CAN eat. For example, our brochure says ‘eat two fish meals per week for good health,’ not; don't eat X fish.” Later he added, “Weighing the risks against the benefits has always been an issue for us. This really factors into our analysis and our recommendations.”

Although the majority of the respondents in the study opted to not change their behavior at all, previous studies, such as that by Oken et al. (2003), reveal that pregnant women did reduce their consumption of fish when they were exposed to a national mercury advisory. These changes in behavior may have larger public health implications because fish confer nutritional benefits to the mother and infant.

To assist in meeting these goals, the researcher recommends improvements (based on the literature and findings from the survey outlined chapter 4) that can be made to states’ Web sites to help better disseminate information on safe fish-consumption practices.

Recommendations for Improvement: Credibility

On the basis of the results of the study, improvements need to be made to address the shortcomings in the credibility of these sites. Improvements to the credibility should focus on improving those aspects that previous research has found contribute to credibility: the perceived competence of the sites and the objectivity, fairness, and consistency of the content leading to the perception of good will that is exuded by the site.

Improving the site's perceived competence should be considered to increase the technical expertise of the content. This can be achieved by describing the exhaustive process by which scientists conduct fieldwork to collect samples, the subsequent laboratory analysis of the specimens collected, and the calculations that are derived to develop the safe consumption guidelines and levels. This information should not be presented in scientific terms. Rather, site administrators should use language that is easy for a layperson to understand and clearly communicates to the user that extensive measures are being taken by their state to derive accurate, current guidelines in order to protect the health of its citizens. This approach will lend to the objectivity of the recommendations and may be effective in highlighting the unbiased nature of the approach.

Although the states in this study work diligently to present an objective, fair, balanced message, one that addresses the importance of consuming fish, this perspective may need enhancing. As reflected by respondents' interpretations of a site's credibility, these users do not believe these sites adequately address the pros and cons of fish consumption. Clear statements with recommended amounts and types of fish consumption will remove the "guesswork" that is required to determine what is safe to eat. This approach will communicate recommendations in a straightforward method, which appears to be lacking. By incorporating these improvements, state government organizations will be more likely to exhibit an expression of good will that will resonate with users of their sites and lead to trusted decision making with regard to fish consumption.

The analysis of the survey results indicates that the consistency of the information about contaminants is not only lacking (on the basis of the low credibility scores) but is also significantly predicted by the presentation format or approach of the site. Whereas the presentation format is not a significant predictor of one's knowledge, it is a significant predictor of one's intent to change behavior, and it appears to impact this particular aspect of credibility. On the basis of these findings, developers of these Web sites should pay special attention to the information they are presenting about contaminants and present consistent messages throughout the pages of their site.

Recommendations for Improvement: Usability

Additional improvements can be made to increase the usability of these sites. These recommendations are focused on those aspects that previous research has shown contribute to usability: a Web site's ease of use, use of simple and natural language, scannability of the content, use of consistent terminology and navigation, and the ability to provide the user with an easy exit and the opportunity to request help. The states in this study struggle to convey difficult concepts such as persistent, bioaccumulative toxics (PBT's), varying fish meal sizes, and impacts of contaminants on susceptible populations, to name a few. States should continue to strive for clear explanations, whether they are written or graphical. The need for this improvement appears to be evident to many of the state communicators, and the findings of this study corroborate this belief.

Maine's Eric Frohberg has taken extensive steps to learn what terms his users understand and do not understand. He has held focus groups with residents of his state and has learned that his users understand the terms "omega-3" and "mercury" but struggle to understand what is meant by "PCBs" and "dioxin." He attributes some of their familiarity to other sources of information, where users often hear the former terms in media sources and have become accustomed to them. The developers of Maine's site take these factors into consideration when creating text for their site and print materials to ensure the language they are using is simple and natural. Other states should consider garnering similar information from the residents, when possible, through informal surveys and by speaking to the users of their sites. Leveraging this kind of feedback to enhance their sites will allow administrators to create a more usable experience for consumers.

Communicating a message through visual means is a powerful tool that should be expanded to increase the user's ability to scan the site and make it easier to use. This may provide the "instant gratification" users are often seeking (Smashing Magazine, 2008) when they surf the web and will help convey a message quickly. Some of the states in this study are exploring these approaches.

The graphic in Figure 8 has been created by the Institute of Medicine (2006) as a way to emphasize choices for various groups of consumers. Through the use of color, this graphic highlights information that is important to specific target populations. Shown in

red are fish and seafood choices containing levels of MeHg that exceed recommended safe intakes for susceptible populations and should be avoided. White (albacore) tuna is shown in yellow to indicate that consumption should be limited to 6 ounces per week for the susceptible groups, and the blue categories are those of little concern. The scale on the x-axis helps the reader determine which choices will yield the greatest health benefits and help reduce their intake of contaminants. Utilizing this type of visual approach on the Web will also allow the communicator to build in added functionality. For example, the consumer can click on each bar for a visual depiction of the fish or a graphic showing the recommended meal size one may want to consume.

One important feature of this graphic is that it presents information on fish that are available to consumers through commercial sources, as well as those that might be obtained from local water bodies. Given the large percentage of consumers that obtain their fish from commercial sources, as noted in Chapter 1, state fish-advisory Web sites should consider providing safe consumption guidelines for fish obtained through either source.

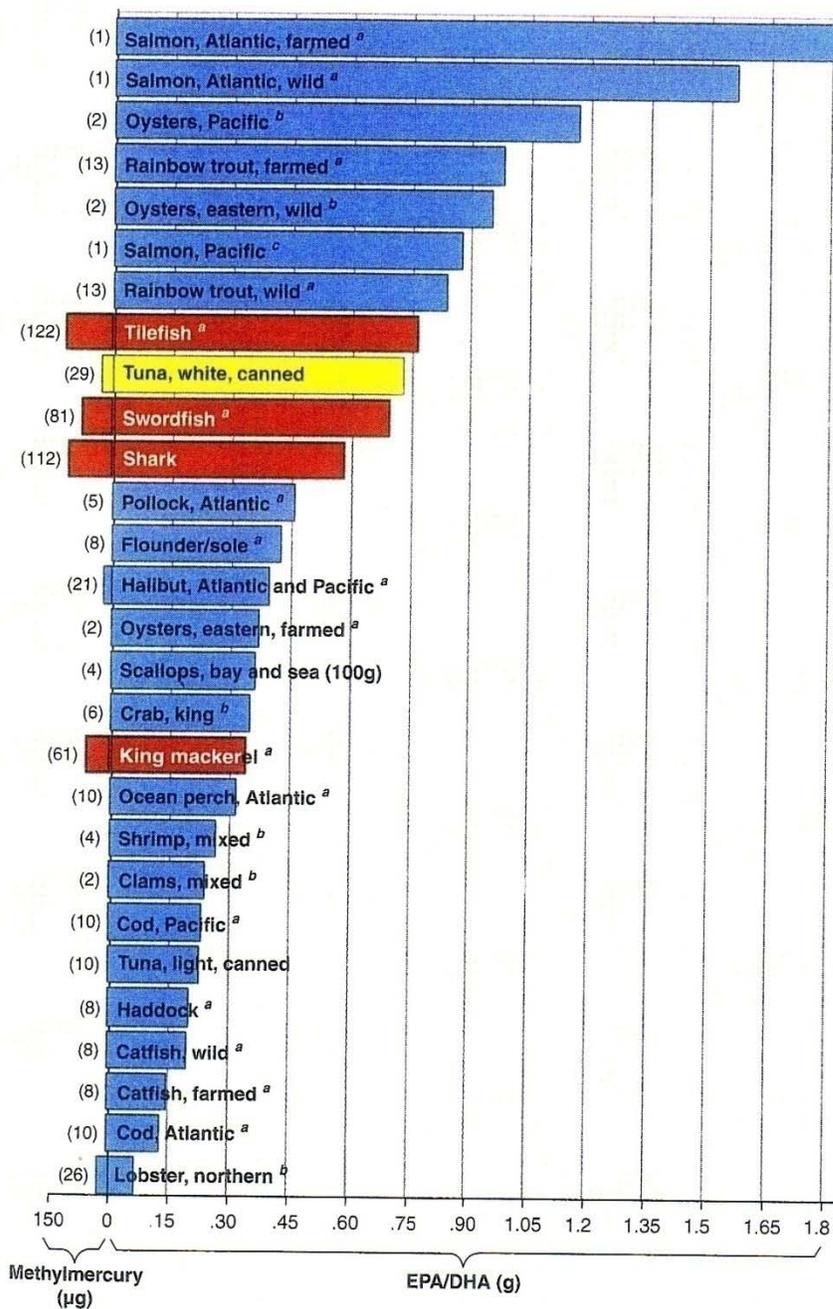


Figure 8. Estimated EPA/DHA (grams) and Methylmercury (micrograms) Amounts in One and Two 3-ounce Fish and Seafood Servings per Week Amounts (Institute of Medicine of the National Academies, 2006).

Maryland's John Hill also discussed an excellent application for using video on one's Web site:

“PCBs concentrate more in fatty tissue. The dorsal meat of the fish is very low in fat, and the lateral line and belly meat/belly flap is very high in fat. Amazingly, our lab studies have shown a 70-90% reduction in PCB concentrations between these different portions of the fish! So we'd like to encourage people to consume only the dorsal meat. This difference has been shown in the literature, but we actually have data to prove this. I'd like to have our field scientist develop a YouTube video (and post it on our site) showing how to skin the fish so they can get the dorsal meat. Our director is seriously considering this.”

Finding funding to develop such a video will likely be a challenge, but it would serve as a useful tool and one that could increase the usability of the site as a whole.

Another key factor in a site's usability is its navigation structure. The open-ended responses in the survey revealed that many users of both sites were frustrated with the navigation. They expressed the difficulty of returning to the homepage or guidelines and felt they needed to rely on the back button in their browser to find the information they were looking for. These are aspects that should be improved to limit the frustration by the user and ensure that consumers will return to the site for future information needs.

The analysis of the survey results also indicate that the consistent use of technical terms is not only lacking (on the basis of the low usability scores) but is also significantly predicted by the presentation format or approach of a site. Whereas the presentation format is not a significant predictor of one's knowledge, it is a significant predictor of one's intent to change his or her behavior, and it appears to impact this particular aspect of usability. As a result, developers of these Web sites should consider the use, placement, and consistency of the technical terms they are using on their sites.

On the basis of the findings of this study, it appears that state fish-advisory Web sites would benefit from usability testing of their sites. This type of testing would allow state representatives to hear directly from their users which aspects they would improve in order to make the sites more usable. Given that state budget resources are limited, this may be a difficult activity to accomplish; however, consultants or administrators could utilize many of the findings from this study to develop appropriate environmental risk communication materials that effectively inform the public on safe fish-consumption practices.

It is important to note that this study, while it contributes to the literature on environmental-risk communication, has certain limitations.

Limitations and Strengths of this Research

It was anticipated by the researcher that many of the independent variables, as shown in the conceptual framework, would influence a respondent's knowledge of risks and intended change in behavior. However, the findings of this study show that only a few select variables had an impact on these factors. The reliability analysis of the independent variables of usability and credibility showed a relatively high degree of reliability of these measures. However, both Web sites in this study ranked very low in terms of these measures. Had these rankings by the respondents been higher, the results may have shown a greater influence of these variables.

Additionally, conducting a reliability analysis on the dependent variables in this study was not possible because the questions used to generate the knowledge score and behavior change score were measured on varying scales. Perhaps the measurement of these dependent variables was not strong enough to detect an accurate measure of change and may have influenced the findings in this study.

Another possible explanation for the lack of positive findings may be due to the fact that the sample size for this study was relatively small and homogeneous and that, in some cases, the data were constrained. These limitations may have made it difficult to detect certain trends in the data that may have otherwise resulted in significant findings.

Even though the findings from the survey in this study are not generalizable to a broader population, they are illuminating. Similarly, the findings from the interviews conducted with state communicators, although not generalizable, show strong similarities in the approaches to managing these sites across many states. As such, the recommendations presented in this chapter should be applicable to other states whose sites were not directly tested in the study.

Additionally, this study resulted in two reliable indices, one of usability and the other of credibility. Each index can be used as a scale to measure usability or credibility for future studies assessing these attributes. More broadly, the methodology followed in this study can be replicated to review Web sites from other states, or those issued by the federal government, conveying safe fish-consumption guidelines to assess their effectiveness in communicating risk and changing behaviors.

The ultimate goal is to reduce environmental pollution by contaminants such as mercury, PCBs, and dioxins. This reduction would allow everyone to derive the health benefits of a marine diet free from contaminants (Oken et al., 2003). In the absence of this ecological state, fish-consumption advisories delivered through the Web give us the most up-to-date information on what we should or shouldn't consume in large quantities. Although these Web sites may not be perfect, they are a convenient, inexpensive way to communicate environmental risks and aid the process of social learning by consumers.

APPENDIX 1: RECRUITMENT LETTER TO PARENTS

[Insert date]

Dear [Insert school name] Parent,

I am conducting a small-scale survey on the fish consumption habits of local families and their opinions of certain Web sites about the safety of consuming fish from state waterways. **I'm writing to request your participation in this study by taking part in a short survey which will be conducted online.**

This survey is being sent to all parents affiliated with [Insert school name], as well as other schools in the area. As you will see, the survey asks parents to assess various characteristics of Web sites communicating State-issued information about safe consumption of local fish. It will also ask you about your environmental beliefs and basic demographic information. The survey will be conducted online and will take approximately 20 minutes to complete. Participation in this study is voluntary and all responses will remain anonymous. In return for your time, you will be given a \$10 gift card from Baskin Robins Ice Cream store to thank you for your contribution to the study.

In order to participate, please click on the following link to access the survey: <http://www.surveymonkey.com/s/N5H2XX7> . This survey may be completed from any computer with an Internet connection. Upon completion, please email the final page of the survey to me or print it out and return it to [Insert school administrator] in exchange for your gift card.

Your support of this study will allow me to gain a better understanding of which tools and concepts are most effective in communicating about environmental risks over the Internet. Ultimately, the findings from this study will be incorporated into my doctoral research in Environmental Science and Policy at George Mason University in Fairfax, Virginia. I would be happy to answer any questions or address any concerns you may have about this study. Feel free to contact me by phone at (xxx) xxx-xxxx or through email at sschappe@gmu.edu.

Sincerely,
Seema Schappelle

APPENDIX 2: SURVEY QUESTIONS

Fishing for Information: A Study on Web Sites Conveying Fish Advisories

Page 1: Introduction Page

Welcome!

This survey is targeted towards parents with young children, such as you. In this survey, you will be asked to rate the characteristics of a Web site that contains information about the safe consumption of local fish by you and your family. After completing the survey, you will be given a \$10 gift card to Baskin Robbins Ice Cream store by following the return instructions.

This survey will ask you questions on your opinions of the Web site, your environmental beliefs, and demographics (all of which will remain anonymous). Please remember, you are encouraged to refer back to the Web site mentioned in the survey while answering the questions. It is also important to remember that this survey is intended to test the effectiveness of the Web site—not a test of your knowledge or ability.

Your contribution to this project will help further the research in communicating environmental risks and how to make these communications more effective. Thank you for your time and contribution.

Page 2: Informed Consent Form

RESEARCH PROCEDURES

This research is being conducted to assess which tools and concepts are most effective in communicating about environmental risks over the Internet. If you agree to participate, you will be asked to complete a short 2-part online survey on your computer. This survey will seek to assess various characteristics of Web sites containing State-issued information about safe consumption of local fish. The survey will also ask you about your views about the environment and a small amount of basic demographic information (e.g., age, gender, etc). This survey will take about 20 minutes to complete.

RISKS

There are no foreseeable risks for participating in this research.

BENEFITS

The benefits to you include a greater awareness of online State-issued information about possible contamination of local fish by pollutants. In addition, you will be helping to further research in the effectiveness of online risk communication techniques.

CONFIDENTIALITY

The data in this study will be strictly confidential. Only information about the name of the school with which you are affiliated will be collected. All information will be reported in ways that do not identify individuals. While it is understood that no computer transmission can be perfectly secure, reasonable efforts will be made to protect the confidentiality of your transmission.

PARTICIPATION

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party. Participants in this study will receive a \$10 gift card for a local store when the final completion page of the survey is printed and returned to the student researcher.

CONTACT

This research is being conducted by Ms. Seema Schappelle of the Department of Environmental Science and Policy at George Mason University. Ms. Schappelle may be reached at (xxx) xxx-xxxx or at sschappe@gmu.edu for questions or to report a research-related problem. Ms. Schappelle's faculty advisor, Dr. Julianne Mahler, may also be contacted at (xxx) xxx-xxxx or at jmahler@gmu.edu. You may contact the George Mason University Office of Research Subject Protections at (703) 993-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research. The George Mason University Human Subjects Review Board has waived the requirement for a signature on this consent form. However, if you wish to sign a consent, please contact Seema Schappelle. In order to print this form, please select "File," then "Print" from your Web browser's menu.

Page 3: Pre-test Questions

Pre-test Questions

Pre-test Q.1. My child attends the following school:

- Bannockburn Nursery School
- Belair Cooperative Nursery School
- Bethesda Cooperative Nursery School
- B'nai Israel Nursery School
- East Columbia Preschool
- Har Shalom Early Childhood Education Center
- Rockville Community Nursery School
- Rockville Presbyterian Cooperative Nursery School
- Silver Spring Nursery School
- Stevens Forest Nursery School
- Other: _____

Pre-test Q.2. In general, I think eating fish and seafood is safe.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Pre-test Q.3. My family and I consume fish and/or seafood:

- About once or twice a week
- About once or twice a month
- A few times a year
- Never

Pre-test Q.4. I have recommend to others to consume fish and/or seafood:

- About once or twice a week
- About once or twice a month
- A few times a year
- Never
- Not Applicable (I tend to not make such recommendations.)

Pre-test Q.5. In order to vary the Web sites that respondents visit, please select the answer choice below according to your last name.

- My last name begins with the letters A-M
- My last name begins with the letters N-Z

Page 4: Link to State Web Site

Many of the questions in this survey will ask you about features and characteristics of the Web site linked below. Generally, this site contains information about the safe consumption of local fish by you and your family.

1. Click on the link below and spend at least 5 minutes surfing this site so you are familiar with its features and the information it is trying to convey. A lot of the questions in this survey are based on your experience with this site, so it's important to spend time looking around.
2. Take a look through the homepage and the lower level pages to see what's available on this site. In particular, make sure you take a look at the state's fishing guidelines.
3. Once you are familiar with the Web site, minimize the screen and return to this survey. Refer back to this Web site as often as you like throughout the survey.

[Link to state Web site provided.]

Page 5-9: Survey Questions 1-37

Survey Questions

Please rate the following characteristics of the Web site you just visited. Refer back to the Web site as often as you like throughout the survey.

Q.1. In my opinion, this Web site seems easy to use.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.2. This Web site uses language that is clear and understandable to me.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.3. This Web site uses consistent technical terms throughout the site.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.4. When looking at the content of this site, I was able to scan the content quickly and easily.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.5. The links from one page to another are easy to find (i.e., show up in the same location) and have consistent titles from page to page.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.6. It is easy to find an exit or find my way back if I wanted to go back to an earlier page.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.7. This site provides an opportunity for help if I felt I needed further information.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.8. The content of this site appears to have a high degree of technical expertise.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.9. The information on this site appears objective and unbiased.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.10. This site appropriately reflects the pros and cons of fish consumption.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.11. The information about contaminants is consistent from page to page throughout the site.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.12. I think this site contains honest, straightforward, and reliable information.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.13. I would be more likely to trust this information if it were from a non-profit organization.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.14. I would be more likely to trust this information if it were from a private firm.

- Strongly Agree
- Slightly Agree
- Neither Agree nor Disagree
- Slightly Disagree
- Strongly Disagree

Q.15. After surfing this site, my family and I are likely to consume fish and/or seafood:

- About once or twice a week
- About once or twice a month
- A few times a year
- Never

Q.16. After surfing this site, I would recommend others to consume fish and/or seafood:

- About once or twice a week
- About once or twice a month
- A few times a year
- Never

Q.17. Based on my use of this site, I learned that the following contaminants could be of concern and may be present in fish (check all that apply):

- Mercury
- Arsenic
- Formaldehyde
- PCBs
- None

Q.18. Based on my use of this site, I learned that the following negative effects can be of concern when consuming fish (check all that apply):

- There is potential for harm to the central nervous system of children and adults.
- There are concerns related to obesity when consuming contaminated fish.
- There are no harmful effects when consuming contaminated fish.
- This site didn't change my view at all.

Q.19. Based on my use of this site, I learned that the following positive effects are shown to exist when consuming contaminated fish (check all that apply):

- Fish are a good source of high-quality protein and nutrients.
- Consuming fish may help increase my bone density.
- There are no beneficial effects when consuming fish.
- This site didn't change my view at all.

Q.20. While surfing this site, I discovered at least one type of fish that my family and I consume was listed as possibly contaminated.

- Yes
- No

Q.21. Based on my experience with this site, I will prepare fish and seafood for my children:

- More often
- About the same as before
- Less often
- Never

Q.22. Based on my experience with this site, I will check for more information on fish and seafood contamination on government or environmental Web sites:

- More often
- About the same as before
- Less often
- Never

Q.23. Are there other things about the Web site you just viewed that made it hard or easy to use? [Open ended response box provided.]

In order to learn a little bit about your thoughts on natural resources and the environment, please answer the following questions. Do you agree or disagree that:

Q.24. The so-called “ecological crisis” facing humankind has been greatly exaggerated.

- Agree
- Disagree

Q.25. The earth is like a spaceship with very limited room and resources.

- Agree
- Disagree

Q.26. If things continue on their present course, we will soon experience a major ecological catastrophe.

- Agree
- Disagree

Q.27. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

- Agree
- Disagree

Q.28. Humans are severely abusing the environment.

- Agree
- Disagree

Finally, in order to learn a little bit about you and your family, please answer the following questions. Please remember, the answers to these questions will remain anonymous.

Q.29. I am:

- Male; Female

Q.30. I fall into the following age range:

- 20-29
- 30-39
- 40-49
- 50-59
- 60+

Q.31. Do you think of yourself as:

- African American
- Asian
- Caucasian
- Hispanic
- Other: _____

Q.32. I fall into the following employment status:

- Full-time employed
- Part-time employed
- Unemployed
- Self-employed
- Unwaged caregiver (of children or adults)

Q.33. My highest level of education completed is:

- None
- High school/GED
- Some college or college graduate
- Graduate school

Q.34. My estimated annual combined family income is:

- Below \$50,000
- \$51,000 to \$70,000
- \$71,000 to \$90,000
- \$91,000 to \$110,000
- \$111,000 to \$130,000
- Above \$131,000

Q.35. I have the following number of children:

- 0
- 1
- 2
- 3
- 4
- 5 or more

Q.36. Do you or members of your family fish on a regular basis?

- Yes
- No

Q.37. Generally, I think of myself as:

- Liberal
- Independent
- Conservative
- Other: _____

Page 10: Completion Page

Congratulations! You have completed the survey.

To receive your \$10 gift card to Baskin Robbins, please:

1. Print this page and return it to your school's administrator OR
2. Email the URL of this page to sschappe@gmu.edu along with an address where you would like your gift certificate mailed. Your address will in no way be linked to your responses.

APPENDIX 3: INTERVIEW QUESTIONS POSED TO STATE REPRESENTATIVES

Q.1. Do you issue (or assist with) communicating information about contamination of fish in your state?

Q.2. How is this information communicated? Is this information made available online?

Q.3. When issuing this information online what protocol(s) do you follow to organize the information you are trying to present? How do you ensure the terms and language on your site are simple and natural? How do you tell how “scannable” the site is or needs to be?

Q.4. How important do you feel it is to use the same terminology throughout your site? How do you decide what level of technical terminology to use? Do you provide users with an easy way back to previous information?

Q.5. Do you provide your users the opportunity to provide feedback and ask questions? What type of feedback do you receive and is it useful or incorporated?

Q.6. When issuing this information online, do you find that it is most effective to present this information using visual aids (such as graphics and map), textual information (mostly narrative), or both? Which method do you use and why?

Q.7. What do you/can you do to show users that the information on your site is objective and represents all relevant points of view?

Q.8. Have you considered conducting usability tests on your site to garner user feedback?

Q.9. What are the number of page requests and unique visitors that your site receives on a monthly basis?

APPENDIX 4: SURVEY PILOT TEST REPORT

The pilot tests on the survey were conducted with five females and one male from September 19, 2010 to October 3, 2010. The lead researcher met with each of the six pilot test participants individually. Each participant was asked to complete the survey online with the lead researcher sitting beside him or her or on the phone. They were encouraged to talk out loud as they completed the survey and pause to share thoughts or concerns along the way at their own pace. Each session lasted approximately one hour. The comments generated from these sessions are summarized and captured below, along with the resulting recommendations for improvements that were made to the survey.

The pilot test participants for this study included the following individuals.

Female

Bethesda, Maryland

Child: Male, Age 4

Female

Vienna, Virginia

Children: Male, Age 4 and Females, Ages 1

Female

Vienna, Virginia

Child: Male, Age 2

Female

Sterling, Virginia

Child: Female, Age 1.5

Male

New York, New York

Child: Female, Age 2

Female

Philadelphia, Pennsylvania

Child: Male, Age 3

Pilot Test Comments and Resulting Recommendations

The content of each page of the survey, as it was originally designed, is included below. Comments that were gathered during the pilot testing are also included.

Page 1: Introduction Page

Survey Title: Evaluating Characteristics of Web Sites used to Convey Environmental Risk Information

Welcome! This survey asks parents to assess various characteristics of Web sites communicating state-issued information about the safe consumption of local fish. The survey will take approximately 25 minutes to complete and needs to be completed all in one sitting. After you're done, please print the last page of the survey and follow the return instructions to receive your \$10 gift card to Baskin Robbins Ice Cream Store.

Please remember you are encouraged to refer back to the Web site mentioned in the survey while answering the questions. It is also important to remember, this survey is intended to test the effectiveness of the Web sites—not a test of your knowledge or ability.

Thanks for your participation!

Comments received on this page include the following:

- Change the wording of the last sentence to: “It is also important to remember that this survey is...” The original statement sounds awkward.
- State that there are 35 questions in the survey so respondents know how long the survey is from the outset.
- This page is clear and straightforward and is consistent with the “handouts” being sent to parents.
- I like the \$10 gift card incentive. This would entice me to take the survey and I think this will increase your response rate.
- I would recommend to left and right justify each page so it is easier to read.
- I wonder if asking people about their “environmental beliefs” may turn them off.
- Mention that the last page of the survey is a completion step. Otherwise, it's not clear why is this important.
- You should make a plea for a person to continue the survey by saying this is critical to your research.
- Make this page more aesthetically pleasing by centering the text and changing the font. This page looks like an “error page!”
- Make the language more clear (or dumb it down) and break the sentences into separate lines. Say “this is a survey for young parents.” Also, move the Baskin Robbins part up to the top so the user clearly sees the incentive.
- Make this intro less sterile, with a personal interest. Make a plea for help, in a professional way. Say “your contribution will help me collect data and contribute to research in the field of science” and say a little bit about you.

- This page is straight forward. Generally, I think the \$10 gift card is good incentive to take the survey. If I had the time, I would opt to take it.

Page 2: Informed Consent Form

The consent form is identical to the text shown in Appendix 2.

Comments received on this page include the following:

- I typically wouldn't read this page. I would just click agree.
- I've never had to read something like this while taking a survey on Survey Monkey. This is kind of new to me.
- I think you should add the purpose of the survey in 3 bullet points at the top of this page. This way, I wouldn't feel the need to read all of the text here.
- Under research procedures. Remove "about" environmental risks.
- Can you provide an example of an environmental risk?
- "This survey will seek to assess..." sounds too jargony. You should simplify this language.
- Can you state that demographic information will not be associated with your identity in the Confidentiality section?
- Why do you give the option to sign a consent form? This makes me wonder if this is the consent form we are looking at. You should state that clearly.
- State in the top yellow bar: "Sponsored by George Mason University." This would say to me that it is applying to research.
- Having the consent form makes the survey feel more official and legitimate.
- I like the benefits section because it touches on the benefits to the research.
- This page is long. Can it be made any shorter?

Page 3: Pre-test Questions

The pre-test questions are similar to the text shown in Appendix 2.

Comments received on this page include the following:

- These seem straight forward.
- I like the horizontal scale; this works well. I dislike vertical scales; they're long.
- In pre-test question #1 "other" sounds odd. Instead you can say: "My child is not affiliated with any of the schools above."
- In question #2, I would want to qualify this statement. I have the Monterrey Bay Seafood Guide app on my iPhone and I'm very concerned about this issue. This

question is very open to interpretation and I don't think I could easily generalize my response.

- In response to pretest question #2, the Gulf spill has made me wonder if eating fish is truly safe. I'm a little less inclined to eat fish now.
- In pre-test question #3 take "about" out. Say "once or twice a month."
- Reword "I tend to not make such recommendations" to "I tend not to make such recommendations."
- It's odd that you're asking me the first letter of my last name. It would be helpful to put this into context with some explanation.
- Selecting your last name doesn't seem odd; I assume this is just how you are segregating your group.
- These questions seem clear. The last question about my last name seems like you are trying to sort the group somehow. This seems fine.

Page 4: Link to State Web Site

The text contained on this page is similar to the text shown in Appendix 2.

Comments received on this page include the following:

- The instructions on this page are clear. I do realize that I can come back to the page if I want to refer to it some more.
- In the instructions add: "The following questions are based on this site and it's important to spend time looking at it." This would help make it clear to me that I need to spend time on the State site.
- Don't use the words "drill down." Say "go to lower level pages beyond the homepage."
- After the first sentence, add another sentence telling the user what the site is (i.e., "This Web site is for _____").
- It would be wise to point the user to specific parts of the Web site through the instructions page. It seems like just saying "surf the site" would be a free for all.

Specific comments about the Maryland and California sites included:

- On the [Maryland] Web site, I like the "how to protect your health while eating fish" information. I also like the "EPA/FDA fish consumption information link."
- "Wow! I didn't know that whole tuna has more mercury than canned tuna. That's a little scary."
- I noticed the contradiction in the information provided on the California site. Here are the good things fish can do for you; here are the bad things. How funny!

- I didn't know that in the mustard of the crab that parts of it can contain contaminants and other parts don't. I like eating crabs, so I found that interesting. I don't typically eat the mustard though.
- I didn't know about these advisories [on the Maryland site]. I was familiar with the overall guidelines about, say, not feeding shellfish to young children before a certain age. But I wasn't aware of these specific advisories.
- When I was pregnant, I hesitated to eat fish. When I between pregnancies I ate quite a bit; about 2 times a week. I really hesitated to eat it when I was pregnant.
- Finfish tissue metal [on the Maryland site]...this is too technical. Cooking and cleaning fish...this also seems too technical.

When asked if the participant tends to trust sources of information issued by federal or state governments, the following replies were given:

- One respondent answered that she tends to trust government sites. They seem to be more authoritative and they are the true source of the information.
- In terms of trusting information online, I do refer to government Web sites, but I like to research issues in depth so I double check the information on an independent site, too.
- This [Maryland] page was updated in 2007...it's too old! This is the problem with government sites; they never seem current.
- I generally trust government sources for information when it comes to health risks. I don't really trust private sites.

Page 5-9: Survey Questions 1-35

The text contained on this page is similar to the text shown in Appendix 2.

Comments received on these pages include the following:

- It is clear to me to refer back to the Web site as I take the survey, per your instructions. (This respondent did refer back and forth to the Web site quite a bit. She felt fairly neutral about the MD state Web site. She felt it was fairly basic.)
- When answering these questions, one respondent commented: "I think that the [Maryland] page is easy to use but the page is not really organized well because there are a bunch of links at the top that aren't in order of importance. It would be nice if the message that they want to get across was clear and at the top of the page. For example, the mercury information isn't grouped together or characterized in one place. This would be helpful.
- When answering these questions, one respondent commented: "I think the [Maryland] site is straightforward and unbiased. I don't think they would have a

hidden agenda. But this information wouldn't necessarily apply to me if I bought fish from Whole Foods or something."

- I didn't know there was formaldehyde in fish! I'll go back to the page and see which contaminants are an issue.
- I expected question #14 to say: "After surfing this site, I would refer this site to others." It might be nice to add a question like: "Now, would you consume a new fish or seafood without researching it?"
- Add a question similar to this: "This site didn't change my view at all."
- In questions #16 and #17, I think the first answer choices are the correct ones. You shouldn't include the right answers as the first choices in each of these questions.
- In questions #16 and #17, add another option stating "I didn't get any of this information from the Web site."
- The transition between the prior questions and these questions was abrupt. Is it possible to include a statement that says, "In the next couple of questions you are going to see are about XYZ?" This statement could be similar to that found on the page with the demographic questions.
- I've never heard of it called "ecological crisis." That sounds a little weird to me.
- I think it's good you are forcing participants to agree or disagree. There is no middle ground.
- Add an open-ended question which gives the user a chance to elaborate why they agree with these questions. And if they disagree, let them elaborate why. Is your disagreement based on a belief system or do they believe it's related to marketing or the media, etc. This gives you insight into their motivation.
- I'm kind of neutral on these questions (questions #23 and #24). I would like to have a "slightly agree" option for these questions, too.
- I think it's interesting you are asking for political affiliation.
- In question #35 "are" is listed twice in the question. Fix that.
- I think you should move question #35 earlier in the survey. You are asking what I did and didn't like about the site, but I viewed the page a lot earlier in the survey. It seems out of context. Maybe make it number #21 or bring in a better lead in to the open-ended question.
- In question # 35, state which "site" you are referring to. It's the State site; not survey, I assume.
- In question #35, it's not clear to me which site you are asking me to assess.

Page 10: Completion Page

Congratulations! You have completed the survey.

To receive your \$10 gift card to Baskin Robbins, please print this page and return it to your school's administrator or email this page to sschappe@gmu.edu along with an

address where you would like your gift certificate mailed. Your address will in no way be linked to your responses.

Comments received on this page include the following:

- The final page of the survey is clear. I understand that I need to print this page to return it.
- Based on your instructions, I would email the URL of this page to you. This seems clear to me.
- Bold the text about your answers not being connected to your address. This would be important to me as a responder.
- Emphasize that you need to print this page and break up the sentence onto different lines to emphasize the steps.
- How would I email this page to you? Clarify these instructions and say that I could either copy and paste the URL, the text, or do a screen capture.

Final Comments received include the following:

- The survey is pretty short and straightforward. That was quick!
- In terms of length, the survey is not too bad (or long).
- Why don't you ask the participant to conduct a task on the site and then ask questions about what they saw or what they would like to see. For example "What fish should you avoid feeding your kids?" Or "how easy was it to find XYZ?" Identify the important things about the site/message and ask the user if they found it. Or "how easy was it to find information about mercury and children?" Just ask them point blank.
- I think you should provide a progress bar across the top of the survey. It would be helpful to know where you are in the survey.
- This survey is shorter than you said it would be in the instructions. Maybe say its 15 minutes of your time, instead 25 minutes.
- Maybe a progress bar would be helpful, so I know how much of the survey remains.
- A few of the participants returned to the State fish advisory Web page and explored it further.
 - One respondent went back to explore the MD state fish advisory page. She was generally complementary of the site and really liked the content. She was pointing out the new things that she learned on the site and hadn't realized before.
 - Another respondent returned to the MD site to look through it since it piqued her interest. She felt this was a very typically government Web site, thought it was very boring, and felt there was room for improvement.

She felt it would be nice if there was more information targeted to a consumer who was actually purchasing fish.

Recommendations for Improvements to Survey

Based on the insight gained from the pilot tests, the researcher implemented the following changes to the survey.

Survey Title:

In order to shorten and clarify the title to make it easier for the respondents to understand, the title of the survey was changed from "Evaluating Characteristics of Web Sites used to Convey Environmental Risk Information" to "Fishing for Information: A Study on Web Sites Conveying Fish Advisories."

Progress Tracker:

A “progress bar” was inserted in the survey showing the amount of the survey that has been completed with each page.

Introduction page:

- The introductory text was changed to the following.

Welcome!

This survey is targeted towards parents with young children, such as you. In this survey, you will be asked to rate the characteristics of a Web site that contains information about the safe consumption of local fish by you and your family. After completing the survey, you will be given a \$10 gift card to Baskin Robbins Ice Cream store by following the return instructions.

This survey will ask you questions on your opinions of the Web site, your environmental beliefs, and demographics (all of which will remain anonymous). Please remember, you are encouraged to refer back to the Web site mentioned in the survey while answering the questions. It is also important to remember that this survey is intended to test the effectiveness of the Web site—not a test of your knowledge or ability.

Your contribution to this project will help further the research in communicating environmental risks and how to make these communications more effective. Thank you for your time and contribution.

Informed Consent Form:

- While this page could be improved, it seemed fairly clear to the pilot test participants. The lead researcher proposes no changes to the text of the consent form since it has been pre-approved by George Mason University’s Human Subjects Review Board.

- To clarify the affiliation of the survey, the title of this page was expanded to:
 - “Informed Consent Form (Sponsored by George Mason University)”

Pre-test Questions:

- The following changes were made to the pre-test questions.
 - Pre-test Q.1.: My child attends the following school:
 - Har Shalom
 - RPCNS
 - SSNS
 - Other [Make this option an open-ended answer in order to learn which school they are affiliated with, if not one of the above.]
 - Pre-test Q.4.: I have recommended to others to consume fish and/or seafood:
 - About once OR twice A week
 - About once a twice a month
 - A few times a year
 - Never
 - Not Applicable (I tend to not to make such recommendations.)
 - The randomization functionality was removed from the question asking the respondent to select their last name. Instead, the first answer choice is associated with the “State of Maryland” page and the second answer choice is connected to the “State of California” page.
 - A short explanation to the question asking the respondent to select their last name was added, as shown: “In order to vary the Web sites that respondents visit, please select the answer choice below according to your last name.”

Link to State Web Site:

Many of the questions in this survey will ask you about features and characteristics of the Web site linked below. Add: This site contains information about the safe consumption of local fish by you and your family.

1. Click on the link below and spend at least 5 minutes surfing this site so you are familiar with its features and the information it is trying to convey. Add: A lot of the questions in this survey are based on your experience with this site, so it’s important to spend time looking around.

2. Take a look through the homepage and ~~drill down to~~ the lower level pages to see what’s available on this site. In particular, make sure you take a look at the state’s fishing guidelines.

3. Once you are familiar with the Web site, minimize the screen and return to this survey. Refer back to this Web site as often as you like throughout the ~~course of the~~ survey.

Survey Questions 7-12:

- Based on the pilot test participants' interest in the credibility of government sources of information, the researcher added 2 additional questions to the survey immediately after Q. 12:
 - "I would be more likely to trust this information if it were from a non-profit organization."
 - "I would be more likely to trust this information if it were from a private firm."

Survey Questions 13-20:

- A fourth answer choice was added to Q. 16 and Q. 17, as shown below.

Q. 16. Based on my use of this site, I learned that the following negative effects can be of concern when consuming fish (check all that apply):

- There is potential for harm to the central nervous system of children and adults.
- There are concerns related to obesity when consuming contaminated fish.
- There are no harmful effects when consuming contaminated fish.
- This site didn't change my view at all.

Q. 17. Based on my use of this site, I learned that the following positive effects are shown to exist when consuming fish (check all that apply):

Fish are a good source of high-quality protein and nutrients.

- Consuming fish may help increase my bone density.
- There are no beneficial effects when consuming fish.
- This site didn't change my view at all.

Survey Questions 26-35:

- Questions # 35 was reworded and moved closer to the questions about the State site (after Question #20).
 - "Are there ~~are~~ other things about the Web site you just viewed that made it hard or easy to use?"

Completion Page:

- The completion page text was changed to the following.

Congratulations!

You have completed the survey.

To receive your \$10 gift card to Baskin Robbins, please:

1. **print this page and return it to your school's administrator OR**
2. **email the URL of this page to sschappe@gmu.edu along with an address where you would like your gift card mailed. Your address will in no way be linked to your responses.**

APPENDIX 5: PARTICIPATING NURSERY SCHOOLS WITH TOTAL ENROLLMENT FIGURES AND SURVEY PARTICIPATION

Nursery School	Number of Enrolled Children/Students	Number of Enrolled Families	Number of Respondents in Survey
Bannockburn Nursery School	51	44	2
Belair Cooperative Nursery School	30	32	8
Bethesda Cooperative Nursery School	44	41	5
B'nai Israel Nursery School	13	13	5
East Columbia Preschool	66	66	17
Har Shalom ECEC	35	35	11
Rockville Community Nursery School	44	44	17
Rockville Presbyterian Cooperative Nursery School	71	66	24
Silver Spring Nursery School	47	42	7
Stevens Forest Nursery School	40	30	3
Other			9
TOTAL		413 Families	108 Respondents

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