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Evaluation of Superfund Research Program websites in a research translation context

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EVALUATION OF SUPERFUND RESEARCH PROGRAM WEBSITES IN A RESEARCH
TRANSLATION CONTEXT

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
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in

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ABSTRACT

The internet is a ubiquitous part of today's society and is used by many as a primary source of information. The National Institutes of Environmental Health Sciences (NIEHS) realized the internet's potential for connecting with stakeholders to transmit the findings of funded groups to make research accessible and applicable to communities and real world situations. This type of information exchange is part of what is known as research translation and is a main component of Superfund Research Programs (SRP) nationwide. Scientific communication is a burgeoning area of study, and little is known about the particular needs of the professional audience in terms of sharing information. This study explores the needs and preferences of the SRP professional audience in order to make recommendations for web design that will facilitate effective web-based research translation. The SRP Website Survey compares websites with opposing traits for each of the following dimensions of usability: comprehensibility, hyperlinks/homepage, layout, relevance, search option, structure, and user friendliness. Thirty-six respondents indicated his/her preferences for each dimension, and statistical significance was found in five areas – layout, comprehensibility, user friendliness, search option and relevance. Based on these findings, SRPs should include a streamlined layout with short navigation menus and present information in short paragraphs or bulleted lists written in non-technical language. The professional audience also indicated a need for a prominently displayed search option as well as a definitions list of jargon they may encounter while exploring a site. The findings and recommendations presented in this study should serve as a template for SRPs to conduct web-based scientific communication and increase audience knowledge and readership.

INTRODUCTION

Since the launch of the World Wide Web in 1991 (Peter 2004), the internet has become a ubiquitous part of today's society with 77% of the United States adult population having consistent internet access (Pew Research CenterProject 2011) and approximately 2.1 billion users worldwide (Miniwatts Marketing Group 2011). Utilizing this technology is an important step in information transmission and has become the focus of many research translation efforts worldwide. The National Institutes of Environmental Health Sciences (NIEHS) developed the NIEHS Portal which allows for information sharing among different organizations providing researchers and decision makers with the tools to function collaboratively and efficiently (Pezzoli et al. 2007). This model has been incorporated into the framework of the NIEHS sponsored Superfund Research Program (SRP) which aims to "provide a solid foundation which environmental managers and risk assessors can draw upon to make sound decisions related to Superfund and other hazardous waste sites." Currently, SRP funds 16 university programs which incorporate an interdisciplinary approach to researching a unique problem related to hazardous wastes, afford training for students, offer outreach to stakeholders and community members, and provide an outlet for research translation -- which is the focus of this thesis (National Institutes of Environmental Health Sciences 2010).

The SRP Strategic Plan challenges each project to conduct research that will be useful to stakeholders and transmit findings not only in traditional methods such as peer-reviewed journals but also web and community resources (U.S. Dept. of Health and Human Services 2010). Research Translation is a process that makes research accessible and applicable in real life situations. According to Welch-Ross and Fasig, scientific communication is a burgeoning area of study that, in part, strives to understand policy makers and the public's comprehension of scientific concepts and the ways in which scientific information is conveyed to and interpreted by intended audiences (Welch-Ross and Fasig 2007). Generally, SRP websites serve two main audiences, the public and

professionals, and each group has different needs, traits, and preferences. Considering user traits and needs creates a site that will yield satisfaction to the target audience yet may be less user-friendly to visitors who are not the main focus of a project's efforts. Because of the differing needs of each audience, this study is focused on the professional user group. An analysis of the SRP websites is of importance because user behavior and preference can be predicted but not fully, and by using this information we can work towards satisfying the needs of the professional users of such sites (O'Connell and Murphy 2007). The objective of this study is to determine the preferences of the SRP professional audience to make recommendations for web design that will facilitate web-based research translation.

Website Usability Characteristics and Evaluation

Usability as defined by the International Organization for Standardization is "the degree to which a product can be used by specific users to reach specific goals with efficiency, effectiveness and satisfaction in a given use context." Website usability is a very important aspect of web design because a poor interface can lead to diminished user productivity and rejection of the system (Alva et al. 2003). Finding the best way to present information to the user is essential to the creation and maintenance of a successful website. There are two main categories of website evaluation, expert-focused and user-focused, with many methods falling under each.

Expert-focused evaluation utilizes expert knowledge from specific areas such as subject matter, design, or audience, in order to uncover usability problems (de Jong and Lentz 2006). An example of this method is heuristic evaluation which tests website usability by examining expert opinions in ten predetermined categories addressing interface design (Avouris et al. 2003). The heuristic criteria are often evaluated on a 5- point scale, and the categories with descriptions of what evaluators are looking for can be seen in the Table 1 (Ryu 2007).

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Table 1. Heuristic criterion for expert evaluation

Web Usability Heuristics	Description
Visibility of current Web page status	Users need to know at each Web page as to "Where am I?" and "Where can I go next?"
Match between the system world and the real world based on targeted users	Word and phrase uses on the website must be familiar to the user
Support user control to Web navigation and relevant links	Users often choose system functions by mistake and will need a clearly marked emergency exit to leave the unwanted state.
Consistent Web design and conformation to standards	Users should not have to wonder whether different words, situations, or actions mean the same thing.
Error prevention with informative contents	Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
Recognition rather than recall	Make objects, actions, and options visible. The user should not have to remember information from on part of the dialogue to another.
Flexibility and efficiency of use for frequent visitors	Shortcuts may often speed up the interaction for the frequent visitors.
Aesthetic and minimal scrolling design	Dialogues should not contain information which is irrelevant or rarely needed.
Help users recognize, diagnose, and recover from errors	Error messages should be expressed in plain language. Every error message should offer a solution (or a link to a solution) on the error page
Help and documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation.

Through the heuristic technique four to five expert evaluations can identify approximately 80% of usability problems (Avouris et al. 2003). However many researchers find fault with this method because it focuses on content and coding issues rather than usability. New approaches to

expert evaluation have been developed in order to ensure that the results better reflect the needs of the target audience. In the CCC (Correspondence, Consistency, and Correctness) model developed by Renkema (2000), experts are asked to complete tasks that a target user may encounter when working with a particular site giving the researchers a more realistic account of site usability. Expert evaluations are more widely used than user-centered approaches because they require less time and fewer resources, but this type of review works best when used in conjunction with user-centered evaluation (de Jong and Lentz 2006).

In user-centered evaluation, subjective feedback is collected from site users in different categories such as satisfaction, quality of work, and efficiency. For this method the users are defined as the people from a target audience who interact with websites with the exclusion of those who have any stake in the website because of their technical knowledge. One such approach is the think aloud usability test where users are given a realistic task to be completed, and the subject verbalizes his/her thoughts while interacting with the site in question. Other methods, like plus-minus or Focus, ask users for their subjective opinions rather than having them interact with a specific site (Wright and Marsden 2010). These evaluation methods give detailed descriptions of user interactions and preferences, but online questionnaires are an effective means of gathering general information about website quality (Elling, Lentz, and de Jong 2007); thus, for this study an online questionnaire is appropriate for the survey of SRP websites.

Sample surveys are the predominant way to measure user feedback and are relatively new data collection tools coming into widespread use in only the past seventy-five years. Survey systems have evolved in conjunction with the technology of the day starting with door to door questioning and progressing to a variety of telephone survey methods (Wright and Marsden 2010) . Today survey work relies heavily on the internet, and in 2006, about 40% of commercial survey research in

the United States was conducted online. Internet surveys are an ideal medium for this type of data collection because a vast number of people can be contacted with great speed and little cost. The surveys themselves can be more detail oriented through the use of visual cues and advanced elements like hyperlinks. The main issue that arises with internet survey use is that of coverage error because internet use and distribution is not equitable across a population (Couper and Bosnjak 2010); however, the target audience of this study consists of professionals and researchers so this bias has been eliminated.

The online questionnaire used in this study is adapted from Elling and colleagues' (2007) Website Evaluation Questionnaire (WEQ). The WEQ was developed to have a higher validity and reliability than other methods or individually produced surveys as a means for comparison of different government sites using the same criteria. The authors explained and executed validity in three ways; first, website quality was evaluated through usability. Next, survey item responses served as a reflection of respondents' objective opinions; the survey did not create new opinions that the users were not aware of while navigating the site. Lastly, researchers enlisted a sample population that was representative of the target audience and minimized sampling error and nonresponse error (Elling, Lentz, and de Jong 2007).

The WEQ was developed by combining the most descriptive and reliable categories of three major questionnaire templates from the literature: the Kirakowski's Website Analysis Measurement Inventory (WAMMI), Van Schaik and Ling's Evaluation of the Intranets, and the Muylle et al.'s Website User Satisfaction questionnaire (WUS). The individualized areas of usability evaluation in each survey and the category titles are compared in Table 2 (Elling, Lentz, and de Jong 2007).

Table 2. Comparison of usability questionnaires considered for the WEQ (Elling, Lentz, and de Jong 2007)

Website Quality Evaluation Elements	Specific Attributes Examined in Evaluation Studies		
	Website Analysis Measurement Inventory	*Evaluation of the Intranets*	*Website User Satisfaction Questionnaire*
User attitudes towards website and its processes	Efficiency, Likeability, Helpfulness, Control	Perceived Ease of Use, Disorientation, Flow	Connection
System Learnability and Outcome Attitudes	Learnability	Perceived Usefulness	Quality of Information, Language
Appearance		Aesthetic Quality	Layout

In the composition of the WEQ Elling et al. (2007) omitted particular categories because they were not applicable to the examination subject of government websites. Learnabilty, which describes the user's ability to learn the system inherent in the website, was eliminated because government sites are likely to have a low frequency of repeat visits. Van Schaik and Ling's Flow category, defined as the feelings of efficiency, motivation, and happiness created through use of a website system, was also left out because the WEQ focuses on informative websites with few processes and applications and little need for motivation of the user. The WUS with its emphasis on finding information and the quality of that information served as the starting point for the creation of the WEQ (Elling, Lentz, and de Jong 2007).

Taking into account the various dimensions in these three questionnaire templates, Elling and co-workers created a preliminary survey and statistically analyzed the results for correlation and reliability. Item reliability was of great importance to the study because it insures that the

dimensions of website quality are measured consistently by each question in the sections. The researchers used the Linear Structural Relations method to calculate item reliability and did not include any dimension that resulted in a reliability of less than .70. Some questions and one dimension were eliminated to increase the reliability of individual categories as can be seen in the following tables (Elling, Lentz, and de Jong 2007). The reliability results are shown in Table 3, and the WEQ questions with omissions are presented in Table 4.

Table 3. Reliability scores of the WEQ calculated by Elling et al. (2007)

Dimension	Number of Items	Reliability
WEQ Total	32	.97
Content	10	.88
Relevance	3	.72*
Comprehensibility	4	.75*
Comprehensiveness**	3	.69
Navigation	19	.96
Ease of Use	3	.90*
Structure	5	.80
Hyperlinks	6	.81*
Speed	2	.76
Search Engine	3	.86
Layout	3	.88
* Denotes one question removed to increase item reliability ** Denotes category removed to increase reliability		

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Table 4. Dimensions of the WEQ with questions (Elling, Lentz, and de Jong 2007)

Dimension	Questions in Elling et al. WEQ
Relevance	I find the information in this website helpful.***** The information in this website is of little use to me. This website offers information that I find useful.
Comprehensibility	I think the information in this website is described clearly.***** The language used in this website is easy to me. I find the information in this website easy to understand. I find may words in this website difficult to understand.
Comprehensiveness******	Certain information I was looking for was missing in this website. The website provides me with sufficient information. I find the information in this website precise.
User Friendliness	I find this website easy to use. I had difficulty using this website.***** I consider this website user friendly.
Structure	I know where to find the information I need on this website. I was constantly being redirected on this website while I was looking for information. I always know where I am on this website. I find the structure of this website clear. The convenient set-up of the website helps me find the information I am looking for.
Hyperlinks (including Homepage)	The homepage clearly directs me towards the information I need. The homepage immediately points me to the information I need. I find the homepage confusing.***** I think it is difficult to spot the hyperlinks on this website.***** It is clear which hyperlink will lead to the information I am looking for. Under the hyperlinks, I found the information I expected to find there.
Speed	I think it takes a long time to download a new web page from this site. I think this is a fast website.
Search Option	The search option on this website helps me to find the right information quickly. The search option on this website gives me useful results. The search option on this website gives me too many irrelevant results.
Layout	I think this website looks unattractive. I like the way this website looks. I find the design of this website appealing.
* Denotes question omitted to increase item reliability ** Denotes category omitted to increase reliability	

MATERIALS AND METHODS

Survey Creation

Because the WEQ is the most closely related standardized survey method to date, it was used as a model for the SRP website questionnaire. Elling et al. (2007) described *routing*, the omission of questions not applicable to the targeted user group, as an option for future application; thus in this study dimensions of speed and redundant questions were eliminated from the final survey. The Speed category was left out in order to tailor the survey to the needs of the SRP professional audience since most users access the sites from fully equipped computers connected to high-speed internet connections. Additionally, some questions were eliminated from the sections because they covered similar areas of inquiry and allowed for users to complete the survey more quickly. The questions included in the SRP Website Survey are shown in Table 5 (following page).

Elling et al. (2007) also conducted an experiment on the relationship between user experience and attitude. The WEQ was used to test the responses of users assigned to groups with tasks of varying difficulty in navigation and level of content then confirmed the responses with verbal feedback from each subject. The results showed that difficult navigation was perceived as significantly more negative than its easier counterpart; however, the more difficult content was not seen as significantly different from the easier content. Some explanations for these differences in response may be attributed to the fact that people tend to focus on the end product rather than the process as long as they are able to complete the task at hand. The researchers also found that the subjects tended to blame themselves for problems they encountered with the systems. Others claimed that they had low expectations of government websites to begin with, so the preconceived standards to which the sites were being held were much lower even when compared to the site with more difficult content and navigation (Elling, Lentz, and de Jong 2007). In this study, the issues of

preconceptions and misplaced positivity were addressed by presenting the user with two different websites with differing formats and functions for each category; with this approach each subject can manipulate the sites and decide which is his/her preference.

Table 5. Usability evaluation dimensions with questions in the SRP Website Survey

Dimension	Questions included in SRP Website Survey
Relevance	The feature on this website would be more useful to me. I would access the feature on this website more often.
Comprehensibility	The language used on this page is easier to understand. The information displayed on this page is easier to understand. The style of writing used on this page is easier to understand.
User Friendliness	I find this website easier to use. I find this website more user friendly.
Structure	I can find the information I need on this website more easily This site is easier to navigate. The structure of this website is more helpful in directing me to the information I am seeking.
Hyperlinks (including Homepage)	It is easier to find links to the information I need from this homepage. On this site it is clearer which hyperlink will lead to the information I am looking for. I found the information I expected to find better through the hyperlinks on this homepage.
Search Option	The search option on this website was easier to locate. The search option on this website gave me more useful results. The search option on this website was more helpful in finding the right information quickly.
Layout	I think this website looks more attractive. This site has the more appropriate amount of information on the homepage. I find the design of this website more appealing

Site Selection

The sites used to evaluate each dimension of usability were selected for their differing traits, and each site was accessed in June 2011. Sites were presented to the user for each dimension of usability being evaluated in the SRP Website Survey; descriptions of the varying traits of sites which qualified them for evaluation in a particular category are listed in Table 6 on the following page.

Layout is a standalone category in the WEQ and describes the look and feel of a website. Information on the web can be displayed linearly or non-linearly. In a linear form, information is presented much like a journal article from beginning to end; users recall the facts better as a result of this display. Non-linear displays break up text with links, graphics, and/or supplemental information; this form allows the user to make mental connections among snippets of information and expand general knowledge of a topic, but it discourages the user from reading an entire article. In linear display more in-depth information may be linked to in the article, but it has been found that it is best placed in a side bar or at the end of an article to prevent the user from jumping from page to page without viewing the necessary information and increasing the risk of disorientation (Martland and Rothbaum 2007).

Navigation is a major component of web design, and as such it encompasses the largest portion of the study dimensions: structure, hyperlinks, search options, and user friendliness. The dimensions describing navigation all relate to user attitudes towards the processes involved in looking for information on the sites. Users gravitate towards sites that make it easy for them to find information. Headlines and text are often noticed even before pictures on a website, so it is important to provide subjects with clear and meaningful content. Layering information on different pages allows users to simply browse a site or do in depth research without compromising scannability and completeness (Nielsen and Loranger 2006).

Table 6. Sites compared in the SRP Website Survey with qualifying attributes

Category	Sites Used	Contrasting Qualities
Layout	Dartmouth College http://www.dartmouth.edu/~toxmetal/index.html	Vibrant colors; pictures; Information on a number of topics displayed
	Boston University http://www.busrp.org/	Muted colors; no pictures; streamlined information
Comprehensibility	University of California- San Diego http://superfund.sdsc.edu/index.php/program_overview/	More technical jargon used, more technical writing style
	Dartmouth College http://www.dartmouth.edu/~toxmetal/research-projects/scientific-goals.html	Little technical jargon and includes definitions; use of bulleted lists
Hyperlinks/Homepage	University of Arizona http://www.superfund.pharmacy.arizona.edu/	Menu bar placed on left side and under banner; greater number of hyperlinks
	Boston University http://www.busrp.org/	Menu bar placed on left side; distinguished resource links under banner and in menu bar
Structure	Oregon State University http://oregonstate.edu/superfund/home	Side menu bar with no drop down menus
	University of California- Berkeley http://superfund.berkeley.edu/	Top menu bar with drop down menus
User Friendliness	Boston University http://www.busrp.org/	Traditional formatting; more individualized menu options
	University of California- Berkeley http://superfund.berkeley.edu/	Non-traditional formatting; more general menu options with more specific drop down menus
Search Options	Northeastern University http://www.northeastern.edu/protect/	Search option is located on a tab in a non-traditional area
	Oregon State University http://oregonstate.edu/superfund/home	Search bar is located on the homepage in prominent position
Relevance	Oregon State University http://oregonstate.edu/superfund/definitions	Defines technical jargon that may be encountered on the site; A-Z "jump to" option
	Boston University http://www.busrp.org/ask.html	Provides information on project researchers so user questions can be directed to the most knowledgeable team member

Martland and Rothbaum (2007) recommend creating visibly distinguishable sections for the varying audiences that sites may cater to; doing so will prevent users from sifting through copious amounts of information and subsections in order to find the topic that relates to his/her inquiries. They also recommend that all necessary links should be constantly visible from a side bar and pages should include links to similar information from within the site.

The search option component is important to the SRP Website Survey because seeking information is a primary use for many of the members of the professional audience. The Pew Internet & American Life Project found that the internet is utilized by 87% of users for research, and 71% of users employ the internet for finding scientific information because of its convenience (Horrigan 2006). Users have diverse needs and levels of understanding when using a website to find information and behave differently; differing styles of searching include exploratory (browsing), existence, topical, known-item, and comprehensive (research). In exploratory searching a user has an indefinite idea of what he/she is searching for and uses websites and search engines as a means to explore topics and increase learning. Existence searching entails users who are looking for information that is congruent with an abstract idea or concept that they are hoping to find. A user will conduct a topical search when he/she knows the basic information to search for but not where to find it; known-item searching is similar to topical searching except users know where to look for the information needed. Comprehensive (research) searches allow users to gain in depth information about a specific topic. In the case of SRP sites, users are generally fall into the latter three categories (Sawasdichai 2007). Assessing the topical, known-item, and comprehensive searching needs of SRP users was addressed in the survey through the search options section as well as portions of the structure dimension.

The final website quality covered by the WEQ is content. Comprehensibility and relevance are similar in that they both describe a site's content, but comprehensibility is based on the writing style while relevance covers the perceived usefulness of the information. When producing web content one can get bogged down in the technical jargon, but it is important to keep in mind that users often are not aware of the meaning of certain terms. When users visit a site to learn more about SRP activities they can become overwhelmed if the content is too difficult. When evaluating content the reader's needs should be considered foremost; for the professional SRP audience, some more technical terms may be used, but writing should be kept concise to allow for quick reading and internalization of the information (Nielsen and Loranger 2006).

In the survey the relevance dimension was converted to website component preference rather than information preference since the information presented on SRP sites tend to be highly specialized and may not be particularly relevant to surveyed users. By asking which feature they favor, inferences can still be made about their preferences without being too discriminating.

Predictions

Based on the standards in the literature, I made predictions about the preferred websites in each category. In the hyperlinks/homepage dimension, both sites have distinguished sections for resources in the sidebar, but I hypothesize that Boston University's site will be preferred because it has additional headings for community and professional resources possibly speeding up search time. Additionally, I think that Boston University's website will be the preference for user friendliness because of the more traditional, logical design. The structural design recommendations previously discussed lead me to believe that the Oregon State University site will be preferred because the sidebar stays in sight while navigating the site which decreases the likelihood of a user getting lost in

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the pages. I also think that Oregon State University's search option will be preferred because it is displayed more prominently than that of Northeastern University.

For the needs of superfund research sites, I hypothesize that non-linear display, as exhibited on Dartmouth College's website, will be the more successful layout for conveying project findings and promoting events. I think that Dartmouth College's site will be preferred in the comprehensibility dimension as well; the University of California-San Diego site uses a more verbose writing style and includes industry language as compared to the Dartmouth College site which uses some elevated vocabulary but breaks up the information into small sections and lists. Providing a definitions list, as shown by Oregon State University's site, is predicted to be more relevant to users. It should be more helpful and keep users on the website and encourage them to delve deeper into the information. A summary of these hypotheses is shown in Table 7 on the following page.

Survey Distribution

FreeOnlineSurveys.com was used as the survey distribution site because of its high level of customization including headings and the addition of hyperlinks. A nonprobablity sampling method was used, and the survey distributed via e-mail to the sampling frame of three-hundred members of the professional audience including government agency employees, individuals in academia, public sector consultants and contractors, as well as other SRP researchers. The survey was open for a two week time span and one reminder e-mail was sent out two days before the survey closed. The survey used can be found in the Appendix.

Table 7. Hypotheses for the SRP Website Survey

Category	Websites Compared	Hypothesized Preference
Layout	Dartmouth College Boston University	Dartmouth College
Hyperlinks/homepage	University of Arizona Boston University	Boston University
User Friendly	Boston University University of California-Berkeley	Boston University
Structure	Oregon University of California-Berkeley	Oregon State University
Search Option	Northeastern University Oregon State University	Oregon State University
Comprehensibility	University of California-San Diego Dartmouth College	Dartmouth College
Relevance	Oregon State University Boston University	Oregon State University

Data Analysis

Descriptive statistics were used to find significance of the preferences indicated by the respondents for both individual questionnaire items as well as categories overall. A Z-test of the proportion was performed for each test with a significance level of .05 (Freund and Wilson 2003).

RESULTS

Each respondent of the Superfund Research Program Website Survey was asked to identify him/herself as one of the predetermined audience components: researcher, professional, or educator. The categorization of respondents can be found in Table 8 below followed by the results of the statistical analysis in Table 9 on the next page.

Two open ended questions were presented to each respondent at the conclusion of the SRP Website Survey. The first was, "other than the website components highlighted in the previous section, what types of features would you like to see on Superfund Research Program websites?", and the responses are displayed in Table 10 on page 19. The second question posed to respondents was, "have you ever accessed any Superfund Research Program sites in the past? If so, please describe your experience and include any suggestions you may have." Fifteen of the respondents had previous experiences with SRP site, and their categorized responses to this question are shown in the Table 11 (page 19).

Table 8. Respondent profession categorization

Respondent ID	Number of Respondents	% of Respondents
Researcher	15	41.7
Professional	18	50.0
Educator	3	8.3
Total	*36*	*100*

Table 9. SRP Website Survey results

Dimension Evaluated	Question #	Number of Respondents	% Preference of Site 1	% Preference of Site 2
Layout**	1	36	94.4*	5.6
	2	36	66.7*	33.3
	3	36	91.7*	8.3
Comprehensibility**	4	36	11.1	88.9*
	5	36	11.1	88.9*
	6	36	2.8	97.2*
Hyperlinks/Homepage	7	36	58.3	41.7
	8	36	55.6	44.4
	9	36	55.6	44.4
Structure	10	35	45.7	54.3
	11	35	45.7	54.3
	12	35	45.7	54.3
User Friendliness**	13	36	30.6	69.4*
	14	36	30.6	69.4*
Search Option**	15	36	16.7	83.3*
	16	35	45.7	54.3
	17	35	40	60
Relevance**	18	36	58.3	41.7
	19	36	72.2*	27.8
Significant item denoted by *				
**Significant category denoted by ** **				

Table 10. Open-ended question 1 responses

Desired Website Components	Number of Times Mentioned
Community Specific Section/Information	4
Links to Collaborative Groups/Stakeholders	3
Links to Policies/Legislation	3
Related Research/Information Links	3
Calendar	2
Factsheets/Multimedia	2
Links to Publications	2
Pictures/Graphics	2
Researcher Profiles	2
SRP National Updates and Links	2
Maps	1
Project Organizational Charts	1

Table 11. Open-ended question 2 responses

Previous SRP Site Experience Comments	Number of Times Mentioned
SRP sites present useful information	3
Usefulness varies from site to site	3
Preference of streamlined appearance	2
Too much information displayed on the homepages	2
Prefer sites with designated sections for varying audiences	1
Preference of simplified language	1
Sites load slowly	1

DISCUSSION

Sources of Error

The number of test subjects required for an effective usability study differs among experts, and much debate has gone into this subject. Bevan et al. (2003) suggested that in some cases one user can identify all the usability errors in a site, while in other evaluation one hundred or more test subjects may be necessary to reach a significant outcome. Nielsen (2004) concluded that the number of users for each test must be evaluated on an individual basis (Moha, Gaffar, and Michel 2007).

This survey yielded a total of thirty-six participants for a response rate of 12%. Nonresponse error occurs because not every subject in the target group will be inclined to participate and is common among web-based surveys (Elling, Lentz, and de Jong 2007). However, recent studies (Keeter et al., Curtin et al., Groves, etc.) have found that very little nonresponse bias, can be attributed to nonresponse rates (Gardner et al. 2007). Nonresponse bias is a source of bias that occurs when all of the recruited subjects do not respond causing the results to only reflect the attitudes of the respondents which may not have been the same as the subjects who declined to participate. If the differences between the respondents and the nonrespondent's are small, then the nonresponse bias will be small even if the nonresponse rate is large. Thus, in this study, since the subjects were selected for similarities to the SRP target audience as well as a connection to the subject matter it can be assumed that the nonresponse rate will have a diminished effect on nonresponse bias (Biemer 2010). The results are based on a small self-selected volunteer base. As suggested by Couper and Bosnjak (2010), self-selected respondents choose to participate based on the subject matter or are interested in the topic, so while a small response rate does present some issues with projection, I believe the results will be valuable in evaluating the effectiveness of websites

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in SRP research translation to a professional audience because only those interested in the subject matter were inclined to respond therefore targeting interested parties likely to access the sites.

Discussion

The preferences of the SRP professional audience are consistent with predictions based on research on website design effectiveness, but there were a few unexpected preferences such as the site choice in user friendliness dimension. Many of the predictions made were found to be accurate after observing the statistically significant data from the respondents' preferences. The table below compares the predictions to the outcomes of the survey (Table 12).

Table 12. Predictions and reported preferences

Dimension	Hypothesized Preference	Reported Preference
Layout	Dartmouth College	Dartmouth College
Hyperlinks/homepage	Boston University	No Preference
User Friendliness	Boston University	University of California-Berkeley
Structure	Oregon State University	No Preference
Search Option	Oregon State University	Oregon State University
Comprehensibility	Dartmouth College	Dartmouth College
Relevance	Oregon State University	Oregon State University

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Recommendations

The results of the SRP website survey were used to develop recommendations for improved web-based communication for Superfund Research Programs (Table 13).

Table 13. Summary of recommendations

Category	Recommendations
Layout	Maximize information, not navigation in the display Minimize need for scrolling Use contrasting text and background
User Friendliness	Keep menus short Consider adding separate sections to accommodate different users
Search Options	Place the search bar in the upper right corner of the page Widen the search bar Use better search software and customize the search settings
Hyperlinks/Homepage	Change hyperlink colors Establish an identity and convey how you can help the user
Structure	Meet user needs and expectations Be consistent
Comprehensibility	Use short paragraphs, bulleted lists, and graphics Include cues that will assist the user in finding information quickly Write in simplified language
Relevance	Include a definition list to inform users of technical jargon they may encounter on the site

The layout of a site is very important to the success of the user. The SRP professional audience preferred the Dartmouth College site; this site portrays many design standards that may have given it the edge in the layout category including the requirement of little to no scrolling, prioritization of information, and utilization of "white space" for topic distinction. The site also dedicates the space to information rather than navigation. Text should be at least 10-points or higher and easily resizable, adequately contrasting to the background, and stand out from design elements. Generally black or dark text on a cool, unsaturated colored background is best suited for

readability. Additionally, no more than four colors should be used in the main area of a website in order to maintain a professional appearance (Nielsen and Loranger 2006).

For the navigation component, SRP Website survey respondents preferred the general menu options with more detailed drop-down menus, and one respondent commented, "Berkeley is a great example of [simplicity]; all the [information] you need is there, but it is very clean and streamlined." Historically, drop-down or cascading menu style was problematic to users, but now users are very accustomed to this type of dynamic element (Nielsen and Loranger 2006). Nielsen recommends keeping menus short and uncomplicated to minimize usability and accessibility problems (Nielsen 2000). A research translation core member noted that his/her, "personal preference is for an extensive navigation bar (or a drop-down menu on a smaller navigation bar) that limits the number of sub-pages you must access to get to your preferred project or core." It is also important to note that separate community information sections, like that of the Boston University site, were requested most often in the opened responses and should be considered as an addition to all SRP sites.

While the search option dimension was statistically significant, the only search option item that showed a significant preference was that of placement. Users liked the prominently displayed search option of Oregon State University's site, but found the rest of the search components to be equal. Internal search engines are only 33% successful compared to the 56% success rate of external sites like Google and Yahoo. To improve internal searches Nielsen and Loranger (2006) recommend investing in better search software because users rely heavily on the search option and take the time to customize the setting for the needs as well as content of your site. Ensure that the most relevant finds are prioritized so the user can quickly find the sought after information. Generally the most visited pages or those with the highest occurrence of a word or phrase are prioritized by search programs, but internal pages can be given preference over others by adjusting settings in the internal

search engine. Lastly, adjust the search text box to a wider setting (usually forty-eight characters) because it encourages users to type more detailed queries which yields more useful finds (Nielsen and Loranger 2006).

The SRP Website Survey did not find a significant preference for either site in the Homepage/Hyperlinks category, but there are a few standards that should always be followed when creating a homepage and its components. According to Nielsen (2000), a homepage should convey four key pieces of information to the user; these are: "what site they have arrived at, what benefits the organization offers them, something about the company and its latest… developments, and their choices and how to get to the most relevant section for them." Generally users only spend thirty seconds on a homepage, so these components must be displayed clearly and succinctly. Another design standard that is integral to the success of the user is to include hyperlinks that change color once they are visited. In one test links did not change color and users tended to get lost and frustrated and leave the site quickly. It is also recommended that links should not open in a new window because many users have pop-up blocking software, have a hard time managing many different windows at once, or do not realize that the window is open and conclude that the link does not work. However, Nielsen and Loranger (2006) suggest that documents such as PDFs and PowerPoint slides should open in a new window because their formatting for the web does not function in the same way as a user would expect for this type of document. For example, the print and text manipulation functions of a web browser do not perform in the same way as a Microsoft Word file, so when users try to adjust the document for their needs things may become jumbled and frustrate the user. Users are also used to "X-ing" out of these types of files, and if a file is displayed in the browser where your page was, it will be lost to the user.

A significant preference for structure was not indicated in the survey, but in general, information architecture is integral to the success of the user. Site structure should be in line with user expectations because a user will not take the time to learn a new system nor will he/she tirelessly search for seemingly hidden information. To avoid a structural disconnect, websites should have a site structure that is intuitive to the user, not necessarily the organization; it is not required that the website follow the structure of the program. For example, research cores are a major aspect of SRPs, but they are not significant for most users. Sites should include core descriptions, but they should be linked to on internal pages with the pertinent topics prominently displayed in menus and on the homepage. While considering such user needs is a good practice, the most important thing to keep in mind when designing a site's structure is consistency. If the navigation is altered from one page to page, the user stops thinking about the content and focuses on how to use the site. Nielsen and Loranger (2006) describes navigation as a means to an end with the purpose of getting a user to the best information in the easiest manner.

The SRP professional audience did prefer the easily scanned text display of Dartmouth College's page which includes shorter paragraphs and bulleted lists. Internet readers are inclined to scan to find the information they need rather than reading a whole page for complete comprehension. Using meaningful headings and cues that can quickly direct the user to the information that they are searching for is highly recommended. Including graphics that can show an activity or concept rather than a lengthy text description is also a good practice. Simple language is best for internet sites; limit or eliminate acronyms because most audience members are unaware of their meanings. It is important to consider the needs and traits of the target audience (Nielsen and Loranger 2006). One survey respondent said he/she appreciated the sites "that are geared more toward a general audience (i.e. have less scientific jargon and more educational resources… It's

easier to digest SRPs that do not just copy/paste their research abstracts verbatim but instead break down the science into simpler relevant terms."

Although short pages are preferred for introductory pages, similar or related information should always be displayed together so the reader can fully understanding the content. The most important information should be displayed first with detail added following the "inverted pyramid scheme" such that a user gets the most important information even if he/she stops reading before reaching the end (Nielsen 2000). For instance, for research core descriptions the page should have a brief plain language description of the goals of each core then follow up with an equally succinct explanation of what they have accomplished and how it may be used in the community. This reinforces the goal of research translation which is to provide consumers with applicable information that is easily understood.

In the relevance category the Oregon State University Definitions List feature was significantly favored; this finding supports the recommendations made by Nielson to include users in the jargon of the field without overwhelming them. Additionally, in the open-ended response questions, two respondents said they appreciated the profiles and would like to see them on more SRP sites. One respondent indicated that he/she "usually [is] looking for researcher expertise… for educational [material], or referral[s] for consolation or collaboration on a specific issue…"

CONCLUSION

This study aimed to uncover the preferences of the SRP professional audience in order to allow for improved web-based transmission of information, and found that some of the group's preferences deviated from common website design standards while other conventions were reinforced. The mixture of convention and innovation in web design as indicated by the professional audience should serve as a template for SRPs to conduct web-based scientific communication and increase audience knowledge and readership.

There are many opportunities for future research in this area including a similar survey targeting the SRP community audience to pin point their unique needs and preferences as well as an investigation into the national NIEHS SRP website. To further elaborate on this survey a study to explore how users utilize and integrate the information from these sites once it has been effectively transmitted.

All in all, the main goal of the Superfund Research Program is to foster scientific discovery and innovation in a manner which will bridge the gap between research and application as a means to better the community at large. Finding the best ways to get scientific information to policy makers, agency officials, activists, and collaborative researches is a large step in the process towards positive change in both our environment and health.

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LSU Superfund Research Program

SRP Website Evaluation

The purpose of this study is to find the best ways to present web-based information to the professional audiences of National Institute of Environmental Health Sciences Superfund Research Programs (SRP).

You will be presented with hyperlinks to two websites for each section of the survey. Please click on the hyperlinks for reference as you respond to questions about your preferences.

This section will evaluate the **layout** *of the following homepages. After viewing the pages, respond to the next three statements by indicating your preference.*

Dartmouth College
Boston University

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1. I think this website looks more attractive.

Dartmouth College	
Boston University	

2. This site has the more appropriate amount of information on the homepage.

Dartmouth College	
Boston University	

3. I find the design of this website more appealing.

Dartmouth College	
Boston University	

This section will evaluate the following project descriptions on **comprehensibility**. *Respond to the following three statements by indicating your preference.*

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4. The language used on this page is easier to understand.

University of California-San Diego	
Dartmouth College	

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5. The information displayed on this page is easier to understand.

University of California-San Diego	
Dartmouth College	

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6. The style of writing used on this page is easier to understand.

University of California-San Diego	
Dartmouth College	

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*This section will evaluate the following sites on **hyperlinks and homepage**. Navigate from the homepages below to the sections related to Professional/Research Resources and Community Resources. Respond to the next three statements by indicating your preference.*

[University of Arizona](#)
[Boston University](#)

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7. It is easier to find links to the information I need from this homepage.

University of Arizona	
Boston University	

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8. On this site it is clearer which hyperlink will lead to the information I am looking for.

University of Arizona	
Boston University	

9. I found the information I expected to find better through the hyperlinks on this homepage.	
University of Arizona	
Boston University	

10. I can find the information I need on this website more easily.	
Oregon State University	
University of California-Berkeley	

11. This site is easier to navigate.	
Oregon State University	
University of California-Berkeley	

12. The structure of this website is more helpful in directing me to the information I am seeking.	
Oregon State University	
University of California-Berkeley	

13. I find this website easier to use.	
Boston University	
University of California-Berkeley	

14. I find this website more user-friendly.	
Boston University	
University of California-Berkeley	

*This section will evaluate the **search options** following sites. Use the search option of each site to find the results of a search inquiry for "Research Translation." Respond to the three statements below by indicating your preference.*

[Northeastern University](#)
[Oregon State University](#)

15. The search option on this website was easier to locate.	
Northeastern University	
Oregon State University	

16. The search option on this website gave me more useful results.	
Northeastern University	
Oregon State University	

17. The search option on this website was more helpful in finding the right information quickly.	
Northeastern University	
Oregon State University	

*This section will evaluate the **relevance** of different features from following websites. Respond to the following two statements by indicating your preference.*

[Oregon State University Definitions](#)
[Boston University Ask a Researcher](#)

18. The feature on this website would be more useful to me.	
Oregon State University	
Boston University	

19. I would access the feature on this website more often.	
Oregon State University	
Boston University	

Other than the website components highlighted in the previous section, what types of features would you like to see on Superfund Research Program websites?

Have you ever accessed any Superfund Research Program sites in the past? If so, please describe you experience and include any suggestions you may have.

Please identify your profession according to the following categories.	
Researcher	
Government or Agency Professional	
Other (Please Specify):	

VITA

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