Finding Governmental Statistical Data on the Web: A Study of Categorically Organized Links for the FedStats Topics Page

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More than 100 U.S. governmental agencies offer links through FedStats, a centralized Web site that facilitates access to statistical tables, reports, and agencies. This and similar large collections need appropriate interfaces to guide the general public to easily and successfully find information they seek. This paper summarizes the results of 3 empirical studies of alternate organization concepts of the FedStats Topics Web page. Each study had 15 participants. The evolution from 645 alphabetically organized links, to 549 categorically organized links, to 215 categorically organized links tied to portal pages produced a steady rise in successful task completion from 15.6 to 24.4 to 42.2%. User satisfaction also increased. We make recommendations based on these data and our observations of users.

Introduction

Over 100 U.S. federal government agencies collect and store statistical data that eventually are made available to the general public. The World Wide Web offers an effective medium for dissemination, but to facilitate access to these statistical data, a common portal with an easy-to-use interface is helpful. Such a portal would help to ensure that the general public, as well as researchers and statisticians, can successfully find the information they seek in the huge amount of information the federal agencies provide.

A major attempt to create such a portal began in 1997, when the FedStats Web site (http://www.fedstats.gov) became publicly available. The site is designed to complement the already existing Web sites of each federal agency by providing a unique point of access to all collections of statistical data from almost 100 different agencies. The Web site is intended to help users find the information they need without having to visit several Web sites and without needing knowledge of the structure of the governmental agencies.

This paper analyzes a portion of the FedStats Web site—"Topic Links—A to Z" (http://www.fedstats.gov/cgi-bin/A2Z.cgi)—to determine its usability and improve it by changing the organization concept. We report on three successive empirical studies of the original and two improved versions, and make recommendations based on task completion, subjective satisfaction, and our observations. These recommendations should be valuable to information architects who are working on Web site design, especially for portal sites that link to multiple Web sites.

Previous Work

Enabling users to find information among the billions of public pages on the World Wide Web is one of the main goals of information architects and interface designers. One study on Web site usability (Spool, Scanlon, Schroeder, Snyder, & DeAngelo, 1999) concludes that users can only find the information they are searching for 42% of the time. Another study (Forsythe et al., 1996) found that 58% of users make two or more navigational errors while searching for information. A survey (Georgia Tech, 2003) found that 66.8% of users believe that one of the biggest problems with the Web is "not being able to find the information that I am looking for." Hargittai (2002, 2003) reports in detail on problems encountered by 97 users of Web sites, such as the U.S. Internal Revenue Service Web site, and points out how design improvements might facilitate usage.

Studies have been conducted to compare concepts for organizing information, such as alphabetical, categorical, chronological, or frequency-based concepts. Four early studies of menu organization (Barnard, Morton, Long, & Ottley, 1977; Card, 1982; Liebelt, McDonald, Stone, & Karat, 1982; McDonald, Stone, & Liebelt, 1983) investigated the use of alphabetized and categorized menu structures. Meaningfully organized menus generally improved performance, although alphabetically organized menus

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were better when users were searching for a given target item. More recent Web-based studies (Bernard & Chaparro, 2000) found that site maps with categorical menu structures are superior to the alphabetized ones in terms of user satisfaction and preference. Their findings showed it was more difficult for users to find information in the alphabetized site map because they had to guess how this information was worded in the menu.

Categorical organization of Web search results has also been shown to dramatically improve user performance in information-seeking tasks (Dumais, Cutrell, & Chen, 2001; Chen & Dumais, 2000). Strong support for multiple categorical groupings of terms (faceted search or simultaneous menus) comes from a study of 32 art history students answering exploratory questions using a novel Web-browsing tool (Yee, Swearingen, Li, & Hearst, 2003).

Commercial Web portals such as Yahoo! developed large menu hierarchies to support novice user exploration and browsing. They chose 14 themes that were organized alphabetically, with 50+ second-level terms shown as well. This success story encouraged others to use alphabetical lists of Web destinations, including the designers of the FedStats topics page. FedStats is a joint effort of more than 100 U.S. federal agencies to make their statistical data tables and reports more accessible to the public. However, the alphabetical list with 645 links was seen as difficult to use by many observers. Similar alphabetical lists are used on many government, academic, and corporate Web sites that provide access to large information resources.

Research on government statistical Web sites has increased under support from the National Science Foundation's Digital Government Program. Existing user interfaces and novel prototypes became the focus of study and experimentation (Marchionini, Hert, Liddy, & Shneiderman, 2000; Hert, Liddy, Shneiderman, & Marchionini, 2003; Marchionini, Haas, Plaisant, Shneiderman, & Hert, 2003). Collections of guidelines (Koyani, Bailey, & Nall, 2003), discussions of patterns (Van Duyne, Landay, & Hong, 2002), and standard texts on information architecture (Rosenfeld & Morville, 2002) focus on Web sites and individual pages and single Web sites. They offer some guidance, but no empirical data, about the design of portal or index Web sites that link to many Web sites created by independent organizations. In order to make progress in understanding design methods for portals that link to existing Web sites, we believed that it was necessary to develop appropriate methods for assessing efficacy of user interfaces that were suited to diverse users for diverse tasks. Novice users with poor literacy skills might be trying to find information about current job prospects while expert users might be compiling important surveys of the demographic differences in cancer death rates across 3,140 counties over a 20-year time period.

Empirical Study

Materials

To provide a foundation for design and testing, Hert developed a scenario-based approach to statistical information networks (Hert, 2002). Working with government agency staff, Hert distilled the extensive logs of citizen requests into 15 scenarios. Starting with these 15 scenarios, we chose three that represented three levels of information need:

- *Construct an understanding:* The question as well as the answer is very elaborate and the source of information to be searched is not clear from the context.
  Scenario: "I'm a social activist in the Raleigh-Durham, North Carolina, area and have become increasingly concerned about urban sprawl and the loss of rural areas for both farming and recreation. I need statistics to support my claim that significant differences occur when urban development occurs in rural and/or farming areas."
- *Search for specific data:* The user only needs to locate information.
  Scenario: "I would like to open a grocery store specializing in organic products in the greater Seattle metropolitan area. What are the trends in production and consumption of organic food products? Would the Seattle area be a good place to locate?"
- *Comparative search:* The user has to look for information regarding an interaction between two phenomena.
  Scenario: "I'm contemplating a move from Seattle to Bozeman, MT. How do they compare?"

We chose scenarios with results that were obtainable through the FedStats Topics Links—A to Z site and for which there were clearly defined Web pages or reports that provided appropriate information. Any choice of specific queries or scenarios can bias empirical studies, but we utilized the same scenarios across all three studies, so as to avoid bias.

The studies evaluated three organization concepts. We started with the original version (reported in Ceaparu, 2003) and then developed two revised versions of the FedStats Topic Links—A to Z site (Table 1):

1. *Alphabetical list of destination links* (original FedStats site: http://www.fedstats.gov/cgi-bin/A2Z.cgi): The links are ordered alphabetically and they point to reports, tables, and charts associated with keyword topics (Fig. 1).
2. *Categorical list of destination links* (http://www.cs.umd.edu/hcil/govstat/fedstats/fedstats2.htm): The links from the original version were grouped by categories and subcategories, rather than being listed alphabetically, and

TABLE 1. Layout differences between the three organization concepts of the FedStats Topics Web site.

Organization concept (no.)	Study 1: Alphabetical list of destination links	Study 2: Categorical list of destination links	Study 3: Categorical list of portal links
Links	645	549	215
Keywords	722	645	305
Lines	838	822	778
Categories	0	16	16
Subcategories	0	52	50
Redundant links	96	0	0

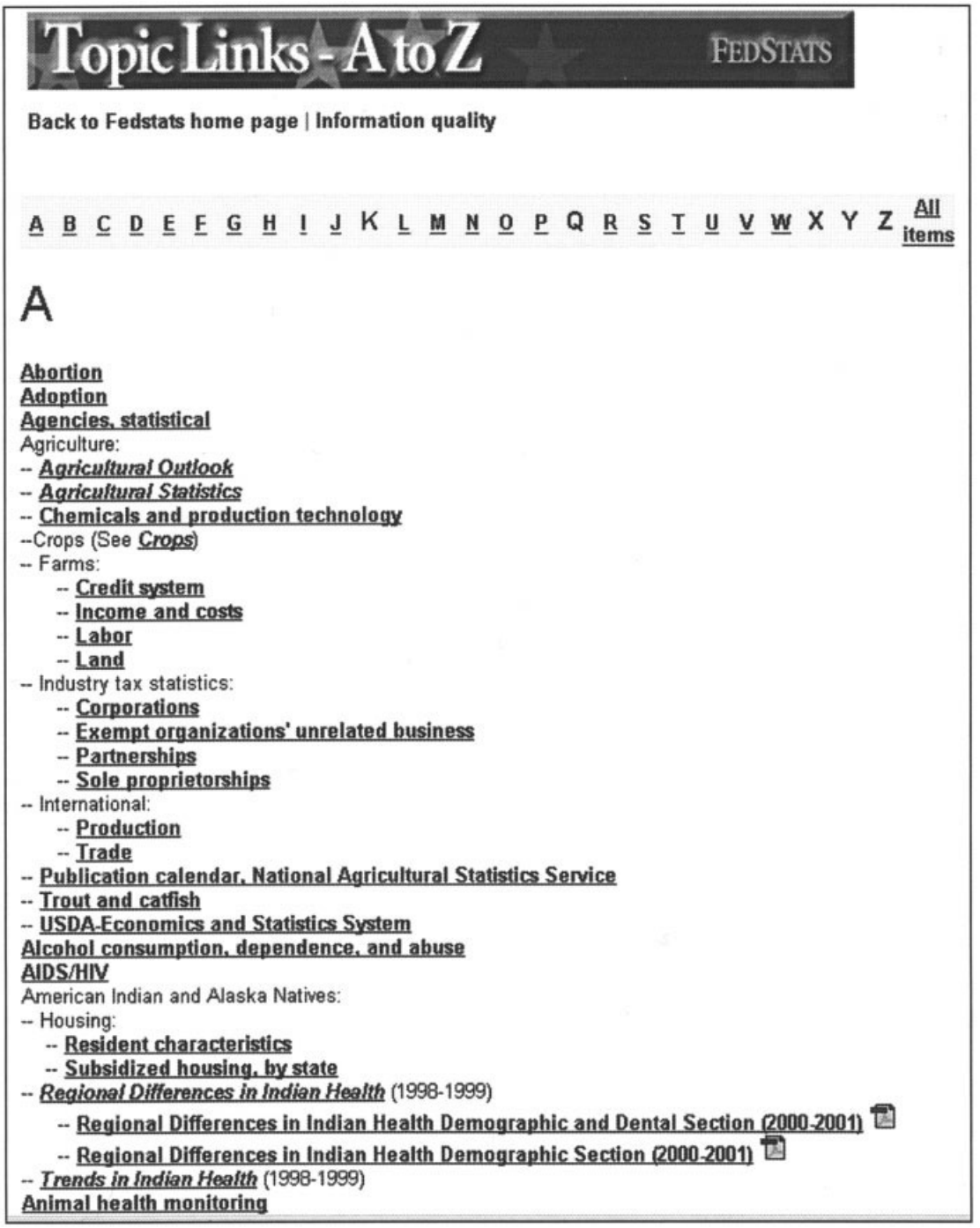
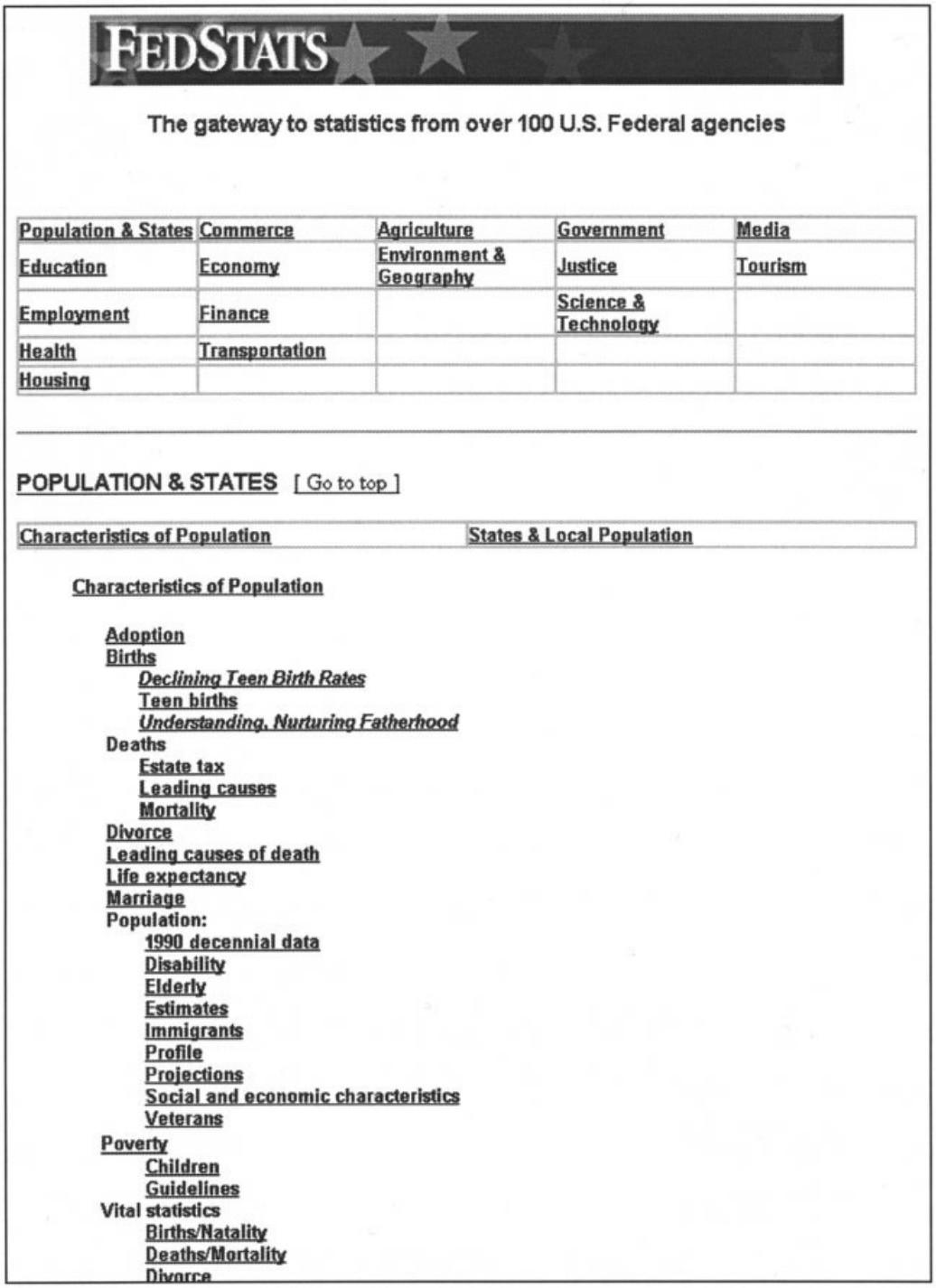


FIG. 1. Original version of the FedStats Topic Links—A to Z: Alphabetical list of destination links (Retrieved March 17, 2004, from http://www.fedstats.gov/cgi-bin/A2Z.cgi).

they point to reports, tables, and charts associated with keyword topics (Fig. 2).

3. *Categorical list of portal links* (http://www.cs.umd.edu/hcil/govstat/fedstats/fedstats3.htm): The links are grouped by categories and subcategories and they point to the Web site of the governmental agency or institution that provides the report, table, or chart associated with keyword topics (Fig. 3).

Categories were chosen from the *Statistical Abstract of the United States* (a collection of statistics on social and economic conditions in the United States) and the *USA Statistics in Brief* (a supplement to the *Statistical Abstract of the United States* that presents national summary data and state population estimates). There are 31 categories in the *Statistical Abstract* and 18 in the supplement. We compiled these categories into a list of 16 main categories (Agriculture, Commerce, Economy, Education, Employment, Environment and Geography, Finance, Health, Housing, Justice, Government, Media, Population, Tourism, Transportation, and Science and Technology) and 50 subcategories.



FEDSTATS

The gateway to statistics from over 100 U.S. Federal agencies

Population & States	Commerce	Agriculture	Government	Media
Education	Economy	Environment & Geography	Justice	Tourism
Employment	Finance		Science & Technology	
Health	Transportation			
Housing				

POPULATION & STATES [Go to top]

Characteristics of Population	States & Local Population

Characteristics of Population

- Adoption
- Births
  - *Declining Teen Birth Rates*
  - Teen births
  - *Understanding, Nurturing Fatherhood*
- Deaths
  - Estate tax
  - Leading causes
  - Mortality
- Divorce
- Leading causes of death
- Life expectancy
- Marriage
- Population:
  - 1990 decennial data
  - Disability
  - Elderly
  - Estimates
  - Immigrants
  - Profile
  - Projections
  - Social and economic characteristics
  - Veterans
- Poverty
  - Children
  - Guidelines
- Vital statistics
  - Births/Natality
  - Deaths/Mortality
  - Divorce

FIG. 2. Second version of the FedStats Topic Links—A to Z: Categorical list of destination links (Retrieved March 17, 2004, from http://www.cs.umd.edu/hcil/govstat/fedstats/fedstats2.htm).

The second version of the FedStats Web site grouped the links from the original Web site into categories and subcategories in a first attempt to improve the navigation process and to reduce the search time. It also eliminated almost 100 redundant links found on the original version.

The third version maintained the grouping by categories and subcategories (with minor revisions of the subcategories) from the second version but removed the original links and replaced them with links to the agency, institution, or department that had information and data relevant to a specific topic. This allowed grouping of topics under one link and also indicated where topics that were not listed in the keywords could be found. A four-step set of instructions at the beginning of the main page indicated an efficient way to use the Web site to find the information. The concept was to go to the portal home page and do a keyword search on the portal Web site.

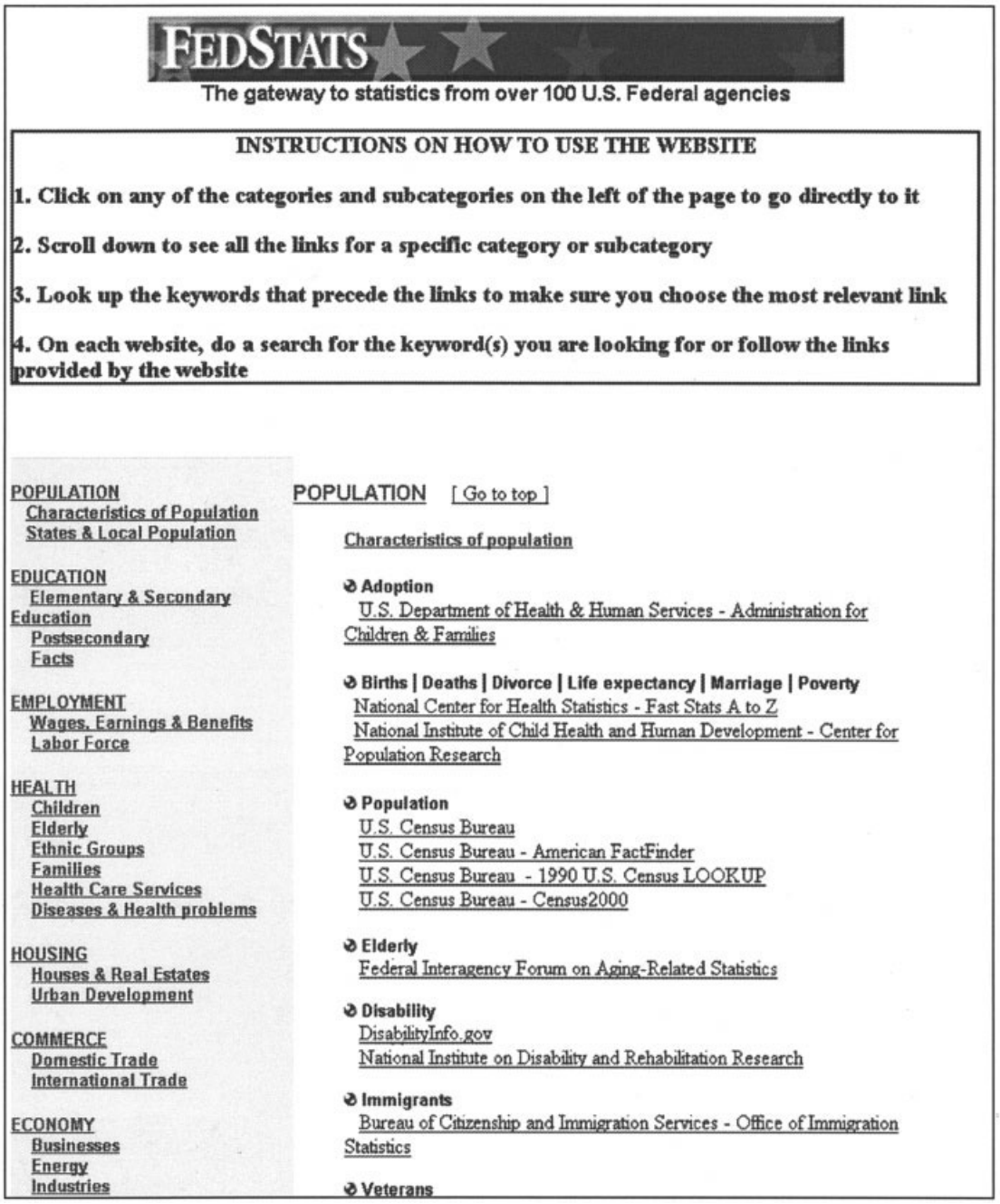


FIG. 3. Third version of the FedStats Topic Links—A to Z: Categorical list of portal links (Retrieved March 17, 2004, from http://www.cs.umd.edu/hcil/govstat/fedstats/fedstats3.htm).

Procedures. We conducted a pilot test to verify the correctness and usefulness of the procedures. The pilot study helped refine the observation methodology and provided a list of the most common and frequent types of frustrations the participants might encounter during the study. Then the three studies were run over a 10-month period, with every effort to keep the same methods and environment, although slight changes were introduced to reduce variations in participant experiences.

All the participants were given the three scenarios mentioned above. They were asked to find the answers to the scenarios using the FedStats Web site within a 10-minute limit for each scenario. The brief 10-minute limit facilitated experimentation and was held constant across the three studies. A think-aloud protocol was used in which participants were asked to describe their thought processes as they carried out their exploration. This standard usability testing technique gave us a deeper understanding of the participants' plans, understandings, and reactions than we would have gotten from merely logging their actions. The main dependent measure was correct completion of each scenario. After each scenario, the participants were asked to fill out a short questionnaire intended to reflect their opinions about the scenarios and the results they got, about the Web

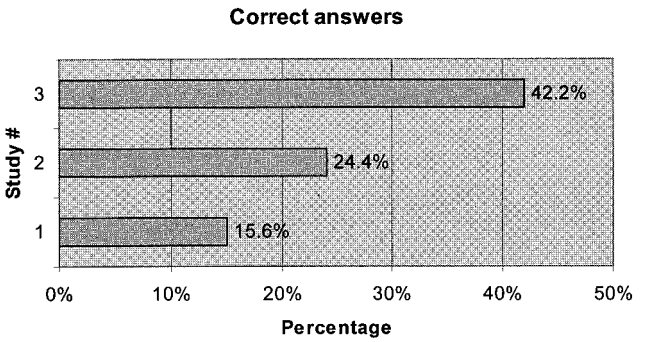


FIG. 4. Each bar represents percent correct answers out of 45 tasks.

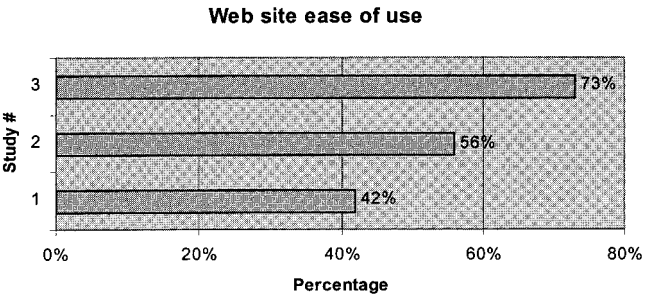


FIG. 6. Each bar represents percent of participants (n = 15) who found the Web site easy to use.

site ease of use and usefulness, and about the level and type of frustration they experienced during the study.

Participants. All three studies were conducted with 15 participants, males and females, with different backgrounds: Computer Science, Library and Information Sciences, Economics, French, Sociology, Electrical Engineering, MBA, and Medical Studies. A new group of 15 was recruited for each study. The first group consisted of 9 males and 6 females, the second consisted of 12 males and 3 females, and the third consisted of 9 males and 6 females. All were graduate students at the University of Maryland.

Results

The results included the number of correct answers, the post-test subjective satisfaction questionnaires, and the observations made during the study. The number of correct answers found for all 45 tasks in each study increased from 15.6% in the first study to 24.4% in the second to 42.2% in the third (Fig. 4). The experimenter could easily judge correct and incorrect answers for these three scenarios.

Shifting to the subjective questions, we report: "How useful was the FedStats Web site?" The percentage of participants who found the Web site useful increased from 35% in the first study to 47% in the second to 69% in the third (Fig. 5).

One of the questions asked the participants to rate on a scale from 0 to 10 the Web site ease of use. The percentage of participants who found the Web site easy to use (above average) increased from 42% in the first study to 56% in the second to 73% in the third (Fig. 6).

One of the questions asked the participants to rate on a scale from 0 to 10 the amount of time spent to complete the task. The percentage of participants who thought they spent too much time (above average) decreased from 58% in the first study to 55% in the second to 32% in the third (Fig. 7).

During the first study, the following types of frustrations were also reported by the participants:

- Could not find links to any keyword in the query,
- Need more related links of the type "see also,"
- Need search keyword option on Topics A–Z page,
- Obvious keywords missing,
- Topics were confusing,
- Use easier-to-understand language,
- Need geographic granularity by cities,
- No "cost of living calculator," and
- No way to set up comparative statistics.

The participants were asked to talk freely about the experience with the Web site. Here are some of their comments:

- Having a background or familiarity with this kind of research would probably help greatly.
- FedStats was close to useless.
- There is too much data.
- Can I go to Google?

The participants' requests related to easier navigation through the huge number of links and their desire for less confusing topics guided the design of the second version of

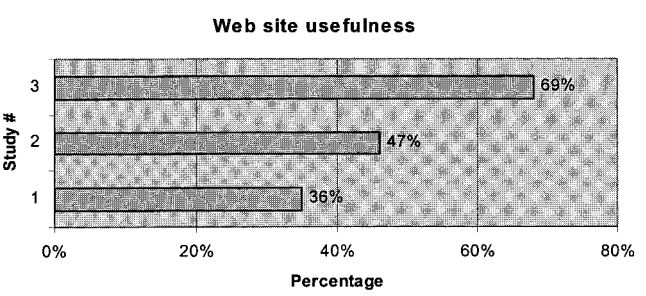


FIG. 5. Each bar represents percent of participants (n = 15) who found the Web site useful.

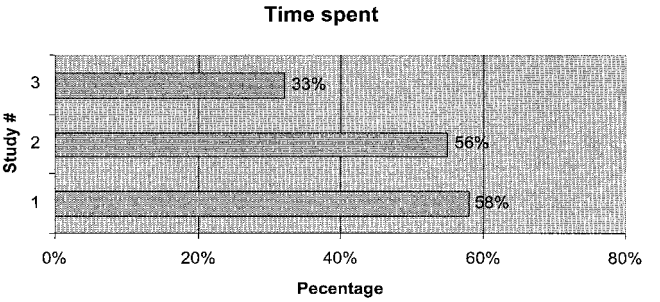


FIG. 7. Each bar represents percent of participants (n = 15) who thought they spent too much time on searching.

the Web site. We addressed these issues by grouping the links under 16 categories and 52 subcategories that would point users to scan for information in a restricted number of links. We hoped this would not only increase success rates but also reduce the user's level of frustration related to not knowing how to explore a large collection of information.

During the second study, participants were able to find the information they were looking for more easily and quickly, provided the information existed on the Web site. However, since they were restricted to the reports, tables, and charts to which the links pointed, they could not search past the information available directly from the links. Also, they reported the following frustrations:

- The links are too specific.
- No explanation of links and weird choice of wording for the links.
- The name of the link suggests the possibility of finding relevant information but the link turns out to be useless.
- The amount of information is overwhelming and specific data are hard to locate.
- The Web site does not seem to be built for the general public.
- No "cost of living calculator."

The third version of the Web site was designed to address the users' complaints about the huge number of too specific links that proved to be misleading in most cases. The solution adopted was to change the links from destination links to portal links. This reduced the number of links from 549 to 215 since more than one topic could be found on the same portal Web site. Also, the name of the links and the keywords that preceded the links guided the users and facilitated the navigation process. For example, instead of separate links to specific tables of data, the terms Births, Deaths, Divorce, Life Expectancy, Marriage, and Poverty were grouped, and then links to two agencies were listed (National Center for Health Statistics and National Institute of Child Health and Human Development).

During the third study, the participants were more at ease with the Web site and were able to navigate easily and locate the information they were looking for. Still, the following frustrations were reported:

- Lack of a centralized search function,
- Too much information on one page,
- Not sure how to handle multiple criteria queries, and
- Category headings could be improved.

Discussion

These three studies assessed the advantages and the shortcomings of the FedStats Web site, a major portal to U.S. governmental statistics on the World Wide Web. Our results should encourage the designers and administrators of the FedStats Web site to pursue the improvements brought by the third version (category links to portal sites). A revised site could have a higher rate of successful users, since it is easier to navigate and less frustrating. Our presentations to the FedStats steering committees received a warm response and a redesign influenced by these studies is planned.

While our usability study had a narrow scope of tasks and users, it provided sufficient insight and experience to justify future studies. Future studies should include a wider range of scenarios and more diverse participants. The 10-minute time limit may have been an impediment for some users. In addition, relaxing our controls by conducting ethnographic studies of users who come with their own tasks could be useful in determining the efficacy of any new design.

In summary, users were more successful in finding answers for our three scenarios when the Web site had 215 links to portals organized by 16 meaningful categories, rather than an alphabetical listing of 645 links to specific tables. The categorical list of portal links led to higher rates of successful exploration and higher levels of subjective satisfaction. We believe that these empirical assessments of information architecture design issues help push this new discipline toward rigorous validations and measurement of the benefits of the many recommendations being made.

While the main focus of this project was to determine the efficacy of three organization concepts, we also observed the performance of our 45 participants. The thinking-aloud process gave us an understanding of the participants' problems, leading us to a set of conjectures that could guide future research. Based on these studies and related work (Shneiderman, 2000), we believe that dissemination of statistical information should be governed by at least the following design principles:

1. *Universal usability:* The interface should accommodate the diversity of users: not only expert users, but also first-time and one-time users should be able to easily access and find the desired information. In the case of the FedStats original version, we found that most of the participants were confused by the design of the Web site, and even after the second task they did not "learn" the interface. The second and third versions both made the participant feel more comfortable with the Web site and more confident that the information needed could be found through the Web site. Usability with slow modems, small screens, voice browsers, and other universal usability tools should be tested (Shneiderman, 2000).
2. *Easy navigation:* The information available should be presented in a structured way. In the first study, all participants indicated that a home page containing categories by topics, categories by agencies, and a search function would best serve their needs. An alphabetical list of topics slows down the search process, especially when it cannot ever be complete from the user's point of view. In the case of FedStats, participants indicated frustration when searching the A–Z topics without finding keywords they were expecting to find. The second and third studies tried to accommodate the participants' needs for more organized information. The presence of categories and subcategories helped the participant navigate through the overwhelming amount of information. The third version of the Web site, with portal links and keywords suggesting what kind of information can be found through those links, reduced the time spent on

irrelevant links and allowed the participants to quickly decide what path to follow.

3. *Common language:* The terminology used to present the information available should be easy to understand. Most users searched for common terms and often missed finding their desired results. For example, to find information on "cities" users had to look under the not-so-common phrase "metropolitan areas." Also, the agencies should not expect the users to know the structure, the exact role of each agency, or the interactions between agencies.
4. *Comparative search and data tools:* The Web site should allow a comparative search and other common-use ways of viewing and analyzing statistical data, for example, easily comparing housing costs in two cities. In the third scenario, participants had a difficult time because they had no way to perform a comparative search or use a cost of living calculator. The third version added a link to a cost of living calculator, to verify its usefulness. Although the queries answered using this feature were not reported in the final results, most of the participants found the link and wanted to use it in order to answer the third scenario.
5. *Advanced search:* The search feature should have full functionality. It should support a comprehensive search through the huge amount of data available, support logical operators, and provide relevant output. In the case of the original version of FedStats, although the search box was the most commonly used method to find the answer to the scenarios, in most cases it provided useless output and sometimes misled the participant by not correctly implementing the use of logical operators. For the second and third studies, participants complained about the lack of a centralized search function that would allow them to search all the Web sites that had links on the front page.
6. *Data granularity:* Allow users to choose the granularity of the information searched in terms of geography and time. In the case of FedStats, participants were often not able to find the information at the city level, being offered data only at the state or county level. Additionally, participants expressed the desire to be able to choose the time interval for which they want to search for data.

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References

Barnard, P.J., Morton, J., Long, J., & Ottley, E.A. (1977). Planning menus for display: Some effects of their structure on user performance. Proceedings of the International Conference on Displays for Man-Machine Systems. IEEE Publication, 150, 130–133.

Bernard, M.L., & Chaparro, B.S. (2000). Searching within websites: A comparison of three types of sitemap menu structures. Proceedings of the Human Factors and Ergonomics Society 44th Annual Meeting (pp. 441–444). Santa Monica, CA: Human Factors and Ergonomics Society.

Card, S.K. (1982). User perceptual mechanisms in the search of computer command menus. Proceedings of Human Factors in Computer Systems (pp. 190–196). New York: ACM Press.

Ceaparu, I. (2003, Winter). Finding governmental statistical data on the Web: A case study of FedStats (pp. 1–17). IT & Society, 1(3). Retrieved March 17, 2004, from http://itandsociety.org

Chen, H., & Dumais, S.T. (2000). Bringing order to the web: Automatically categorizing search results. Proceedings of Human Factors in Computing Systems (CHI'00) (pp. 145–152). New York: ACM Press.

Dumais, S.T., Cutrell, E., & Chen, H. (2001). Bringing order to the web: Optimizing search by showing results in context. Proceedings of Human Factors in Computing Systems (CHI'00) (pp. 277–283). New York: ACM Press.

Forsythe, C., Ring, L., Grose, E., Bederson, B., Hollan, J., Perlin, K., et al. (1996). Human factors research and development for the internal Web at Sandia National Laboratories: A review and update. Proceedings of the 2nd Conference on Human Factors and the Web. Retrieved March 17, 2004, from http://www.microsoft.com/usability/webconf/forsythe.rtf

Georgia Tech Research Corporation. (2003). GVU's WWW User Surveys (1994–1998). Retrieved March 17, 2004, from http://www.gvu.gatech.edu/user_surveys/

Hargittai, E. (2002). Beyond logs and surveys: In-depth measures of people's Web use skills. Journal of the American Society for Information Science and Technology, 53(14), 1239–1244.

Hargittai, E. (2003, Winter). Serving citizens' needs: Minimizing hurdles to accessing government information online. IT & Society, 1(2). Retrieved March 17, 2004, from http://www.stanford.edu/group/siqss/itandsociety/v01i03/v01i03a03.pdf

Hert, C. (2002). Developing and evaluating scenarios for use in designing the National Statistical Knowledge Network. Retrieved March 17, 2004, from http://ils.unc.edu/govstat/papers/scenario_paper_nov_14_2002.doc

Hert, C.A., Liddy, E.D., Shneiderman, B., & Marchionini, G. (2003, January). Supporting statistical electronic table usage by citizens. Communications of the ACM, 46(1), 52–54.

Koyani, S., Bailey, R.W., & Nall, J.R. (2003). Research-Based Web Design & Usability Guidelines. Washington, DC: National Cancer Institute, National Institutes of Health. Retrieved March 17, 2004, from http://www.usability.gov

Liebelt, L.S., McDonald, J.E., Stone, J.D., & Karat, J. (1982). The effect of organization on learning menu access. Proceedings of Human Factors Society, 26th Annual Meeting (pp. 546–550). Santa Monica, CA: Human Factors Society.

Marchionini, G., Haas, S., Plaisant, C., Shneiderman, B., & Hert, C. (2003). Toward a statistical knowledge network. Proceedings of the 2003 National Conference on Digital Government Research. Retrieved March 17, 2004, from http://www.dgrc.org/dgo2003/

Marchionini, G., Hert, C., Liddy, E., & Shneiderman, B. (2000). Extending understanding of Federal statistics in tables. ACM Conference on Universal Usability (pp. 132–138). New York: ACM Press.

McDonald, J.E., Stone, J.D., & Liebelt, L.S. (1983). Searching for items in menus: The effects of organization and type of target. Proceedings of the 27th Annual Meeting of the Human Factors Society (pp. 834–837). Santa Monica, CA: Human Factors Society.

Rosenfeld, L., & Morville, P. (2002). Information architecture for the World Wide Web (2nd ed.). Sebastopol, CA: O'Reilly & Associates, Inc.

Shneiderman, B. (2000, May). Universal usability: Pushing human-computer interaction research to empower every citizen. Communications of the ACM, 43(5), 84–91.

Spool, J.M., Scanlon, T., Schroeder, W., Snyder, C., & DeAngelo, T. (1999). Web site usability: A designer's guide. San Francisco: Morgan Kaufmann Publishers.

Van Duyne, D.K., Landay, J.A., & Hong, J.I. (2002). The design of sites: Patterns, principles, and processes for crafting a customer-centered Web experience. Reading, MA: Addison-Wesley.

Yee, K.-P., Swearingen, K., Li, K., & Hearst, M. (2003). Faceted metadata for image search and browsing. Proceedings of Human Factors in Computing Systems (CHI2003) (pp. 401–408). New York: ACM Press.