

# User - Centered Web Based Information Architecture for Senior Citizens

*Panayiotis Zaphiris*

Institute of Gerontology and  
Dept. of Industrial and Manufacturing Eng.  
Wayne State University  
Detroit, USA  
[p.zaphiris@wayne.edu](mailto:p.zaphiris@wayne.edu)

*Sri H. Kurniawayn*

Institute of Gerontology and  
Dept. of Industrial and Manufacturing Eng.  
Wayne State University  
Detroit, USA  
[af7804@wayne.edu](mailto:af7804@wayne.edu)

## ABSTRACT

The present study utilized the card sorting technique and cluster analysis to define the best information architecture of Web health information for senior citizens. Sixteen senior citizens participated in the card sorting, twenty in the category identification and thirteen in category labeling experiments. Senior citizens participating in the study tended to group the tested items conceptually at the higher level but tend to group the items based on common words found in the titles at the lower level of the hierarchy. The study also found that user grouping produced more heterogeneous structure than the Dmoz set-up information architecture. Category labels suggested by seniors were observed to be less formal than the Dmoz category labels.

**KEYWORDS:** Senior-centered design, Information architecture, card sorting, health information.

## INTRODUCTION

### Health Information and Aging

U.S. Census Bureau [15] projected that by the year 2030 people aged 65 and above will represent 20% of US population. Although older adults are still underrepresented as computer users, more and more are beginning to incorporate the Web as part of their lives, currently representing 13% of the online [5]. One of the main uses of computers for senior citizens is to look for health information [16,4].

This increase in computer and web usage by senior citizens is expected to follow a similar pattern in other countries too. As the current youth who is getting more and more dependent on the internet/web in performing daily activities (entertainment, shopping, studying) gets older, we will experience a more dramatic increase in senior citizen web usage. This makes the study of aging issues effecting web usage a necessity.

This significant increase in the older computer user population has led to various studies investigating the age effect in utilizing the Web. Some findings suggested

that older adults have some disadvantages in fully utilizing the Internet as an information source. That is, older people have more trouble finding information in a Web site than younger people [17]

However, little effort has been placed to ensure that health information on the Internet is structured to help older computer users to find the desired information easily and efficiently.

In addition to age-related problems of searching for information on the Internet, senior citizens often face various problems when searching specifically for health information. Research reviewing medical and health related web sites listed the following problems:

- Although those sites are attractive, they only function as "yellow pages" [4].
- It is difficult to find specific information and it contains content of varying quality [7].
- There is a potential for serious abuse and conflict of interest because of the profit acquired from selling an advertiser's products [3].

For most topics, inability to find the proper information (or to find the information in a timely manner) might not bring severe consequences. However, the case is different in health and medical areas. Hence, it is crucial to make certain that online health and medical information is structured in a way that would enable users to find the information easily and efficiently.

This study investigated ways to better structure and information architecture of Web health resources and to be more intuitive to senior citizens. Previous studies showed that unintuitive web link labels might lead users to a wrong path or caused disorientation, which render users unable to find the information [13].

### Senior-Centered Design

We propose the term senior-centered design to refer to any design methodology that involves older users in the

process of designing products that are targeted towards the aging population [18].

A more senior-centered approach to designing web site structures requires understanding of senior citizens' perceived relationship of web site components. One method of collecting this data is through the use of card sorting.

### **Card Sorting Technique**

An important step in organizing the content of a web site is to place the information on the web site according to how individuals typically view information [1,2]. A well-constructed taxonomy will help end users to locate the desired information quickly and accurately and a badly constructed taxonomy might contribute to a waste of time and effort without obtaining the desired information [8].

The organizational structure of a Web site can have a profound effect on its ease of use. An ideal structure would allow users to navigate efficiently through the site, while a less-than-ideal structure might make users unable to achieve their goals in information search. For example, many corporate Internet sites design their web site's structure based on the internal structure of their companies, no matter how conceptually unintuitive the structure is. Unfortunately, most visitors are unfamiliar with the actual structure of the company, and are unlikely to find this kind of site easy to navigate as these sites do not match the user's mental model of the structure of the company.

Similar confusing structures are also evident in health related websites where crucial to the user information is very often buried deep down the hierarchy of the website and this together with confusing, formal, medical terminology often used in these websites makes browsing for the derived information a challenge for senior citizens.

To make certain that the information architecture design matches the way users view information, usability testing needs to be conducted. Usability testing should follow the philosophy that the successful design of a web interface is very dependent on the typical user's mental model of the structure of a web site [1]. Thus, in web site design it is essential to ensure the design of a meaningful structure of information organization, as a meaningful information organization will promote efficient navigation [14]. The optimal information structure should fit the user's mental model [9].

One of the ways to understand user's perceived relationship of various components of the web sites using a formative design support technique is by utilizing the card sorting technique. In the card sorting exercise,

participants are presented with randomly ordered cards representing pages of a Web site, and they are asked to group the cards based on their perceived fit [10].

Card sorting is considered as one of the best usability methods for investigating users' mental model of an information space [19]. The resulting tree structures can be used as a base for organizing the site and for identifying meaningful patterns in the resulting hierarchy which are indicative of general underlying cognitive processes or user mental models. These patterns can then be generalized to form principles and guidelines for organizing Web content [8].

There are two ways to analyze collected data from card sorting experiments: by "eyeballing" the card's grouping trend [10], which is tedious for large number of users; or by utilizing the cluster analysis technique. Cluster analysis of card-sorting data is a promising method for understanding and summarizing multiple participants' input to the organization of Web site pages. Cluster analysis quantifies card-sorting data by calculating the strengths of the perceived relationships between pairs of cards, based on how often the members of each possible pair appear in a common group [10]. The degree of the relationship between any two cards is represented by their similarity score. The output can be displayed in the form of tree diagrams in which the relationship between any two groups of cards is represented graphically by the distance between the origin and the branching of the lines leading to the two groups.

## **METHODOLOGY**

### **Hypothesis**

Two hypothesis are tested in this study. More specifically

1. Senior citizens will label items using less technical and formal terminology than the one employed on the Dmoz (and other health related) websites.
2. Senior citizens will group items using a less conceptual structure than the one employed on the Dmoz (and other health related) websites. More specifically we expect senior citizens in this experiment to group items based on literal words found in the descriptions of the items.

### **Participants**

The experiment was designed specifically to include a representative pool of the prospective users of the tested health information web sites. Sixteen senior citizens aged 55 and above (mean age = 68.69, SD = 5.97 years) participated in the card sorting experiment (experiment 1). A different pool of twenty senior citizens (mean age = 70.41, SD = 13.41 years) participated in the category

identification follow-up experiment (experiment 2). Another new pool of thirteen senior citizens (mean age = 70.69, SD = 8.18 years) participated in the category labeling experiment (experiment 3).

All participants live independently in the community (non-institutionalized) and have no visual and cognitive impairment and functional illiteracy. All participants have at least 13 years of formal education.

### Stimulus Material

The pages used for the whole card sorting experiments were sixty four (64) leaf items taken from the "Health: Aging" hierarchy of Dmoz (<http://www.dmoz.org>) web site from four main categories: Geriatrics, Diabetes and Alzheimer, Life Cycle and Life Expectancy. An example of the original web site structure is pictured in Appendix A-1. Items were carefully selected to be of interest to our participant's age population and of similar title complexity.

### Apparatus

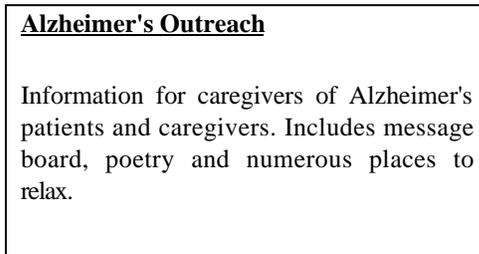
3'x5' Index Cards with the Web link names and short descriptions of the content of Web pages were used in the Card Sorting test. USort and EZCalc software by IBM™ were used for the cluster analysis of the card sorting data. Paper and pencil questionnaires were used for category identification and category labeling experiments.

### Procedure

#### Experiment 1: The card sorting

The link title and a short description of the web page of each of the 64 items was printed on a separate index card. An example of those index cards is depicted in Figure 1.

Each participant was given one set of sixteen (16) randomly ordered index cards from one of the four Dmoz main Health/Aging categories (Geriatrics, Anti aging, Mortality, Well Being). The participant was tested in an individual session to make sure that the grouping was based on individual observation rather than group observation (Figure 2).



**Figure 1:** An example of Index Card used in this experiment

The participants were asked to sort the cards into logical groupings based on the following instructions [18]:

- Please sort these cards into piles such that things that you think go together are in the same pile.
- You can have as many or as few piles as you like.
- The piles do not need to contain the same number of cards: some piles may be very big and others may have one or two cards if you don't think they are sufficiently similar to anything else.
- You can change your mind and move cards around and merge or split piles as you go.



**Figure 2:** One of the participants involved in the card sorting experiment

When they were comfortable with their final sorting arrangement, they were asked to record their card groupings on paper. To aid in understanding the underlying concept of how they group the information, participants were also asked to write down group names and descriptions of why they grouped the items that way. Each participant was then asked to repeat the experiment by using a different grouping strategy.

Because it was predicted that senior citizens might be confused and worried when finding an item that they couldn't group with any of their groups, two options were given: to place the item to any of the existing categories or to list the item as a separate group with the item's name as the group name (some help was provided by asking the participants to use the "thinking out loud" method while creating the categories). In cases where the participants felt that some items could fit into more than one group, they were allowed to list that item in one or more categories.

Next, a cluster analysis was conducted using EZCalc across all participants' card groupings to produce final hierarchical structures.

#### Experiment 2: The category identification

In this follow-up experiment, participants were given pages containing items from the same main category of Dmoz. Each of the pages contained items that were suggested to belong to the same group by the participants of Experiment 1. Each participants in Experiment 2 was then asked to write down a suggested label for each of the groups. In general, across the twenty participants, 3-5 names were proposed for each group.

### **Experiment 3: The category labeling**

The last experiment, the category labeling, involves presenting users with the category labels suggested by the participants of Experiment 2 and the items that belong to that category. Each participant was asked to rank the suggested labels based on their fit to the group (lower number means higher fit). The number was then added up and the label with the smaller sum was the chosen label for the group.

## **RESULTS AND DISCUSSION**

The new hierarchical structure (see Appendix A-2) revealed that, through the use of user feedback (from card sorting experiments), the information structure has transformed from a homogeneous (four items per branch) design of Dmoz to a heterogeneous hierarchy (ranging from two to six items per branch). The users' mental model is more in agreement with a heterogeneous information architecture than a homogeneous one.

Another interesting/surprising observation is that our second initial hypothesis was not supported. More specifically senior citizens participating in our experiment tended to group items conceptually at the higher level of the information structure. In contrary to the commercial grouping of Dmoz where the information was often grouped based on geographic location (e.g. Research Institutions in USA versus Research Institutions abroad), our senior citizen participants tend to group items based on their functionality or service provided (e.g. Institutions about Aging, research centers about diabetes).

This contradicts the general assumption that senior citizens have difficulty to conceptually organize information related to the web. This suggests to web designers that senior citizens will have easier time finding the necessary information in carefully and conceptually organized health related websites targeting senior citizens.

Our participants on the other hand tended to be influenced by common words found in link name titles (e.g. "Longevity" or "Anti-aging") when grouping items at lower level of the hierarchy. This is an other interesting observation, since it reveals that users tend to develop a mental/conceptual organization structure of

information and that structure influences them in organizing lower levels in the hierarchy. More specifically, we think that since our users have developed a conceptual mental model at the higher levels of the hierarchy they follow that model all along and thus find it not necessary to organize the items at the lower levels conceptually since they are already group in that way at the higher levels of the hierarchy.

From the category labeling experiment, new names for the proposed categories were obtained. Category labels suggested by senior citizens were observed to be less formal than the category labels designed by web site experts. Our hypothesis is that these category labels match the user perception better than the information architecture proposed by Dmoz designers. The validity of this hypothesis needs to be tested by a formal usability experiment.

## **CONCLUSIONS**

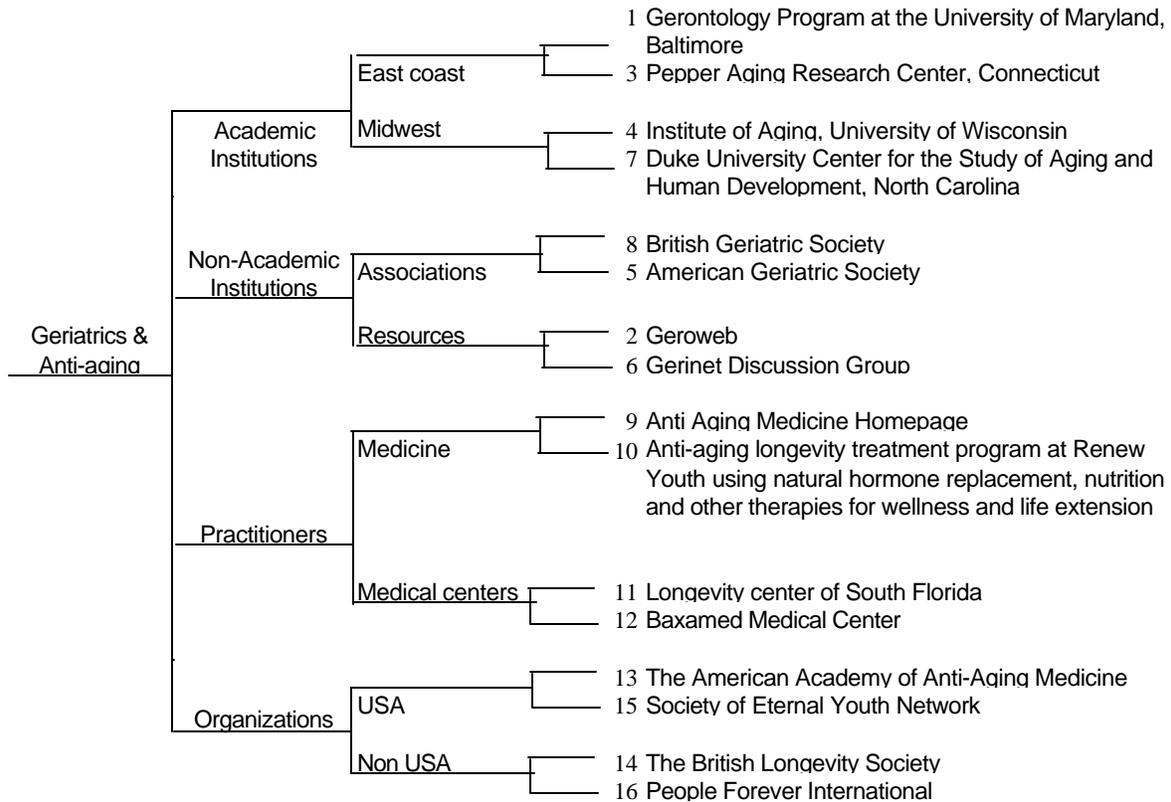
This study applied a series of user-centered design exercises to build a senior-oriented information architecture for health-related information on the Web. The results of the study showed that involving prospective users in the design can capture users' underlying perceptions of different components of the information architecture, including the structure and the labels of the hierarchy. The resulting information architecture is expected to be more user-friendly as we believe it is a closer fit to the user's mental model. The study suggests that web designers should accommodate the needs of users to ensure that their products would appeal to the end-users. More generally, with the Internet being more integrated in various aspects of life, it is necessary to accommodate users with different characteristics (e.g. people with disabilities or older users) when designing the online information architecture. A more hybrid usability methodology is necessary (and is currently in progress) to evaluate fully qualitatively the Dmoz versus senior-centered design hierarchies of this experiment.

## **REFERENCES**

1. Bernard, M. *Constructing User-Centered Websites: The Early Design Phases of Small to Medium Sites*. Usability News, Winter 2000. Available from <http://156.26.16.3/newsurl/usabilitynews/2W/webdesign.htm>
2. Bernard, M. *Constructing User-Centered Websites: Design Implications for Content Organization*. Usability News, Summer 2000. Available from <http://wsupsy.psy.twsu.edu/surl/usabilitynews/2S/webdesign.htm>
3. Bloom, B.S. and Iannacone, R.C. *Internet availability of prescription pharmaceuticals to the*

- public. *Annual Intern Medicines*, 1,31, 1999, pp. 830-833.
4. Cochrane, J.D. *Healthcare @ the speed of thought*. Integrated Healthcare Reports, 1999, pp.16-17.
  5. Cury, J.O. *Young at heart, and online: The over-50 crowd finds empowerment, community and new friends on the Web*. Access Internet Magazine, November 21, 1999, pp. 6.
  6. Elliott, B. and Elliott, G. *High volume medical websites*. Delaware Medical Journal, Vol. 72, No. 1, 2001, pp. 21-29.
  7. Hersh, W. "A world of knowledge at your fingertips": the promise, reality, and future directions of on-line information retrieval. *Academic Medicines*, Vol. 74, 1999, pp. 240-243.
  8. Kanerva, A., Keeker, K., Risdien, K., Schuh, E. & Czerwinski, M. Web Usability at Microsoft Corporation. *Human Factors for World Wide Web Development*. Lawrence Erlbaum, New York, 1999.
  9. Lisle, L., Dong, J., & Isensee, S. Case Study of Development of an Ease of Use Web Site. In *Proceedings of 4<sup>th</sup> Conference on Human Factors and the Web* (June 5, 1998, Basking Ridge). Available from <http://zing.ncsl.nist.gov/hfweb/att4/proceedings/lisle>
  10. Martin, S. *Cluster Analysis for Web Site Organization*. Internetworkings, Vol. 2, No. 3, 1999. Available from [http://www.internettg.org/newsletter/dec99/cluster\\_analysis.html](http://www.internettg.org/newsletter/dec99/cluster_analysis.html).
  11. Murray, G. & Constanzo, T. Usability and the Web: An Overview. Available from <http://www.nlc-bnc.ca/pubs/netnotes/notes61.htm>.
  12. Nielsen, J. & Sano, D. SunWeb: User interface design for Sun Microsystem's internal web. In *Proceedings of the Second World Wide Web Conference '94* (October 17-19, 1994, Chicago).
  13. Oliver, R. & Oliver, H. *Information access and retrieval with hypermedia information systems*. *British Journal of Educational Technology* Vol. 27, 1996, pp. 33-44.
  14. Shneiderman, B. *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 2<sup>nd</sup> edition. Addison-Wesley, Reading, 1992.
  15. U.S. Census Bureau. Projections of the Total Resident Population by 5-Year Age Groups, and Sex with Special Age Categories: Middle Series, 2025 to 2045. Available from <http://www.census.gov/population/projections/nation/summary/np-t3-f.txt>
  16. White, H., McConnell, E., Clipp, E., Bynum, L., Teague, C., Navas, L., Craven, S., & Halbrecht, H. *Surfing the net in later life: A review of the literature and pilot study of computer use and quality of life*. *The Journal of Applied Gerontology* Vol. 18, 1999 pp. 358-378.
  17. Zaphiris, P. Ellis, R.D. Mathematical Modeling of Age Differences in Hierarchical Information Systems. In *Proceedings of ACM Conference on Universal Usability*. (November 16-17, 2000, Arlington).
  18. Zaphiris, P., Kurniawan, S.H. Using Card Sorting Technique to Define the Best Web Hierarchy for Seniors. In *Proceedings of CHI 2001 Conference on Human Factors in Computing Systems*. (March 31 - April 5, 2001, Seattle).
  19. ZDNet Developer. Card Sorting. Available from <http://www.zdnet.com/filters/printerfriendly/0,6061,2253113-84,00.html>.

**Appendix A-1: An example of web site structure from Dmoz of the main category: Geriatrics & Anti-aging**



**Appendix A-2: An example of the result from the card sorting experiment from Geriatric & Anti-aging**

