

The Impact of Web Ability, Age, and Web Experience on Bookmark Organizations

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Abstract

The use of computer technology, particularly Web applications, has grown dramatically over the last five to ten years. Web topics have also expanded into any imaginable aspects of life. Similar trends is happening with the use of supporting Web technology, transforming the Web into a maze with a large numbers of "turns" and "new alleys" that made it sometimes difficult to return to, even for expert users. Among navigational aids, bookmark has been a very useful tool to help Web users remember and retrieve interesting Web pages they had visited. However, managing bookmarks is not a simple task even for expert users.

The current study examined the impact of age, Web experience (the elapsed time since the users started using the Web), and Web ability across the adult's life span on how the users managed their bookmarks. It was hypothesized that Web ability would mediate the effect of age and Web experience on how the users managed their bookmarks. Six hundred surveys, sampled from the Project 2000 data (Novak & Hoffman, 1997), were used to examine this model. Using structural equation modeling techniques, it was found that the effect of age on bookmark organization was fully mediated by Web ability. However, the effect of Web experience was not fully mitigated by Web experience.

Running head: Age, Web ability and Web experience impacts on bookmarks

Key words: Web ability, age, Web experience, bookmark, structural equation modeling

1. Introduction

As Web pages and links became more and more sophisticated and complicated, some users may get lost in the "labyrinths". For even as the maze of hypertext, animation, links to databases, illustrations, and video sequences widens and expands, so too do users change and grow, both in their knowledge of the material they seek to understand and in their development as individuals adjusting to a larger world than they have known before (Halio, 1992). Sensing the need for navigational aids, many hypertext and multimedia designers have provided cognitive tools such as bookmarks, compasses, and filters or geographical browsers that supply a global or zoom lens map that allow users to build personal information spaces (stored as bookmarks, hotlists, or as a personal page of links) as their WWW-subset and interface to access the World-Wide Web. This study will focus on bookmark organization as the way to manage user's personal information space.

WWW is a living "creature" that evolves and grows permanently. Therefore, users have to take care that their personal information spaces can be kept manageable (Thomas & Fischer, 1997). A lot of efforts and studies on "intelligent bookmarks" or "agents" have been conducted to help users manage their personal information space (e.g. Arai, Yokoyama & Matsushita, 1992; Marais & Bharat, 1997; Olsen et al, 1998; Thomas & Fischer, 1997; Voss. & Kreifelts, 1997) but until these systems become standard Web navigating programs, users would have to manage their personal information spaces by themselves. And

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managing personal information spaces could be problematic, especially because there is few guidelines or helps readily available on how to structure the growing list of bookmarks.

Having the facts that the Web now hosts something of interest to computer users with various age, educational backgrounds, and computer experience created a larger range of needs to be accommodated, including the various requirements on the area of Web navigation. Halio (1992) stated that although various cognitive tools to aid Web navigation have been created, less attention has been paid to users' affective needs. The author later suggested to advocate navigational tools to help various types of users such as "returning adult students, mid-life career shifters, women, minorities" to name a few. In other words, there is a need to understand what navigation tools will work in a particular type of users given the variability in the levels of their Web ability, age, and Web experience. Understanding the factors that contributed to the patterns of personal information space organization would be a starting point in this regard.

Previous literatures have pointed to age, education, computer anxiety, computer experience and computer interest as well as computer ability or self-efficacy as some of the potential factors contributing to the patterns of Web usage (Ellis & Allaire, in press; Everhart, 1997; Hemby, 1997; Jay & Willis, 1992; Raub, 1982; Ray & Minch, 1990; Selwyn, 1997). It would be fruitful to investigate whether some of those factors would have the same effect in users' usage pattern of their self-created personal information space, i.e. their list of bookmarks.

In the present study, the effects of age, Web ability (self-efficacy) and Web experience to bookmark organization is of particular interest for a definite reason.

The importance of age

Various studies which investigated the effect of age toward computer and Web usage have increased significantly in the last decade because of the significant increase of older population. Forecasts projected that by the year 2030 people aged 65+ will represent 22% of the people living in the US (U.S. Census Bureau, 1999). At the same time computer and Web technology is rapidly being integrated into most aspects of life. In other words, it is highly likely that, in one way or another, older people will interact with and benefit from computer and Web technology, such as for recreation in long term care settings (McConatha, McConatha, & Dermigny, 1994), for caregiver support (Smyth & Braudy-Harris, 1993), or in other elder interest groups (American Association of Retired Persons, 1998).

Despite proven benefits and receptivity to relevant technology (Czaja, Guerrier, Nair, & Landauer, 1993), older adults remain underrepresented in the overall computer user population. In fact, those aged 65+ constitute about 12% of the population, they only make up about 5% of the online user population (Cortese, 1997).

Several possible explanations could be derived from the aforementioned finding. Henderson et al (1995) found that computer confidence was negatively correlated to age and positively correlated to computer experience. That is, older users have less confidence that they could use Web and computer technology well. Boziolenos (1997) suggested that negative attitude toward computers is considered one of the most important individual factors which inhibited effective use of computers. Briggs, Burford and Dracup (1998) also stressed out that a great deal of research has demonstrated that users' self-efficacy beliefs have a major impact upon their attitudes to technology.

The question remains would be whether this age-related findings would affect the efficiency of personal information space organization which will lead to the efficiency of information search (Meyer et al, 1997).

The importance of Web ability

Briggs et al (1998) described self-efficacy within HCI as self-rated expectations of being able to use computers. In the present study, this self-efficacy is labeled Web ability. The Web ability or self-efficacy was of particular importance because of its effect on attitude toward computers and computer-anxiety (Igarria & Chakrabarti, 1990; Torkzadeh & Angulo, 1992) which will lead to user's acceptance of computer technology (Igarria, Schiffman & Wieckowski, 1994).

The importance of Web experience

Web experience has been the topics of various studies because of its significant impact on Web usage, especially when its effect is linked to age such as learning new software (Czaja et al, 1989), attitude toward computers (Igarria & Chakrabarti, 1990), or software performance and subjective reactions (Whiteside et al, 1985).

Most of previous studies investigated separately or in partial combination the effect of age, Web ability (self-efficacy) and Web experience. In the present study, it was hypothesized that although these three factors would contribute to the way Web users organized their personal information space, the effects of age and Web experience would be mediated by Web ability.

Objectives and Summary of Hypothesis

The objective of this study is to examine the effect of self-rated Web ability, age, and Web experience (defined as the elapsed time since the users first used the Web) toward how users organized their personal information space known as bookmarks. In particular, two questions were addressed: (1) What is the relationship between age, Web experience, Web ability and bookmark organization? (2) Does a theoretically derived model explain individual differences in bookmark organization? and (3) Does any of these three variables have a greater influence on bookmark organization?

2. Methods

The data of the present study was merged data of the Project 2000 Survey conducted by Novak and Hoffman (1997) at the Owen Graduate School of Management, Vanderbilt University and the general demographics and Web usage sections of the WWW User Survey fielded by the Graphic, Visualization, and Usability Center (GVU) at the Georgia Institute of Technology (Kehoe & Pitkow, 1997) available online. The Project 2000 questionnaire consisted of 77 items, administered as a Web-based form that was posted April 10 to May 10, 1997 in conjunction with the 7th WWW User Survey (Kehoe & Pitkow, 1997).

Subjects

Participants of these two studies were solicited by announcements placed on Internet-related newsgroups, banner ads placed on pages on high exposure sites (e.g. Yahoo, Netscape, etc.), announcements made to the WWW-survey list maintained by GVU, and announcements in the media. Of the 3092 completed cases (defined as the individuals with 100% non-missing data), 600 were randomly selected for this analyses. However, due to the initially low numbers of older adults in the full sample, all respondents over the age of 60 years were included.

Procedures and Measures

The Project2000 survey (Novak & Hoffman, 1997) consisted of 77 questions: three sociodemographic questions (age, gender and education levels) and 74 web related questions. The Web usage section of the 7th WWW User Survey (Kehoe & Pitkow, 1997) consists of 18 questions about Web related issues such as usage patterns and problems. The general demographics section of the 7th WWW User Survey (Kehoe & Pitkow, 1997) consists of 27 sociodemographics questions as well as Web related information such as hardware, software, primary place to access WWW, etc.

Demographics. This portion of the questionnaire consisted of sociodemographic items. The subject filled out their actual age, thus allows age to be analyzed as a continuous variable.

Besides age, education, marital status, occupation and gender were recorded for each subject. However, only age was used in the analysis of the present study.

Web experience. Web experience was assessed with a single item, which asked the number of years since the users first used the Web. A rating of '1' means the users started using the Web less than 6 months ago while '6' means the users started over 3 years ago.

Web ability. To investigate which of the web related variables were affected by age, a simple bivariate correlation analysis between the variables and age was run. Only eight variables have moderate correlation with both age (in the range of 0.22 - 0.39) and Web experience (in the range of 0.36 - 0.53). Interestingly the exploratory factor analysis revealed that only one common factor emerged from these eight variables. The general factor described the underlying construct of Web ability.

The observed Web ability is a composite scale of six self-assessed statements with 9-point Likert scale and two statements with 9 discrete points assessing contradicting opinions of how the users feel when they use the Web. The six items consisted of statements such as "I am very skilled at using the Web." The respondents were asked to endorse these items along a scale from "Strongly Disagree" (rated as 1) to "Strongly Agree" (rated as 9). The last two items consisted of statements such as "I feel confused about what to do [when using the Web]" which rated as '1' in one end and "I clearly know the right things to do" which rated as '9' in the other end. The internal consistency for these eight items was high ($\alpha = .91$). The complete set of questions is listed in Table 1. Scores were summed up to create Web ability variable, creating a composite score of 1 to 72.

Insert Table 1 about here

Bookmark organization. To investigate which of the web related variables were affected by both age and Web experience, a simple bivariate correlation analysis between the variables, Web experience and age was run. Only four variables have moderate correlation with both age (in the range of 0.15 - 0.19) and Web experience (in the range of 0.33 - 0.34). Interestingly the exploratory factor analysis revealed that only one common factor emerged from these four variables. The general factor described the underlying construct of bookmark organization.

Bookmark organization variables are binary variables with '1' means the subjects performed a particular bookmark organization manipulation and '0' means the subjects did not. The internal consistency for these eight items was high ($\alpha = .84$). The complete set of questions is listed in Table 2. Scores from these four measures were summed up to create Bookmark organization variable, creating a composite score of 0 to 4.

Insert Table 2 about here

3. RESULTS

The purpose of this study was to investigate the relationships between age, Web experience and Web ability. Analysis focused on: (1) Examining the relationships between these constructs, and their relationship with demographic variables, (2) determining the unique and shared variance of age and Web experience in the prediction of Web ability.

Demographic Details

Table 3 presents the descriptive of sociodemographics data. The subjects ranged in age from 18 to 79 years, with an average age of 42.08 years (S.D. = 14.99 years). The sample was predominantly male (68.3%). Education levels ranged from less than high school to doctoral degree with the majority of subjects either have some college degree or have completed college (60.6%). Most of the subjects are married (59%) and are white (94.3%). Subjects' occupations are more evenly spread, ranging from technical and professional to other various occupations (such as in the military, arts, etc).

Insert Table 3 about here

Web ability and Bookmark organization distributions by Age groups

Table 4 summarized the distribution of Web ability and Bookmark organizations across age groups. In general, a declining trend by age group was observed in both Web ability and Bookmark organizations. That is, older users tend to rate their Web ability lower than their younger counterparts and they also tend to perform less in terms of organizing their bookmarks.

Correlational Relationships

Table 5 contains the correlations between age, Web experience, Bookmark organization and Web ability. The values above the diagonal represent correlations for the observed variables, while the values below the diagonal represent correlations among the latent constructs which were obtained using confirmatory factor analysis (Jöreskog & Sorbom, 1993). Examining the pattern of correlation, age was negatively correlated with Web ability, Web experience and Bookmark organization. Web experience was positively correlated with both Web ability and Bookmark organization. Web ability is positively correlated with Bookmark organization.

Insert Table 5 about here

Latent Relationships

In order to determine the relationship between Bookmark organization, Web ability, Web experience and age, structural equation modeling was employed (Jöreskog & Sorbom, 1993). Structural equation modeling allows one to create latent constructs comprised of several observed variables intended to assess a particular construct. The advantage here is that the relationship between these latent constructs are disattenuated for measurement error. This technique also allows the predictive relationship between all latent constructs to be examined simultaneously. All structural models were estimated using the LISREL VIII program (Jöreskog & Sorbom, 1993). Models with Chi-square estimates less than two times the degrees of freedom (Akaike, 1987; Carmines & McIver, 1981), residual error less than .05 and overall fit indices above .90 were considered adequate fitting models.

Analysis began with the specification of a measurement model where the constructs are correlated to one another. The specified measurement model included some correlated measurement errors of variables that represent the same constructs. This measurement model had an adequate fit: $\chi^2 (68, N = 600) = 126.22$, residual error < 0.05, all fit indices > .90 (see Table 6 for fit indices).

Insert Table 6 about here

Regression model. Next, the hypothesis stating that the effect of age and Web experience on Bookmark organization would be mediated by Web ability was tested. Age and Web experience were allowed to correlate in the model. In this model, although the fit was adequate: $\chi^2 (70, N = 600) = 139.54$ and the other fit indices are good (see Table 6 for fit indices), it was significantly different from the initial measurement model: $\chi^2 \text{ diff}(2) N = 600) = 13.32$. It means, the hypothesized model did not represent the pattern of covariations between factors to be as well as the measurement model. Observing Beta's modification indices, a significant relationship was observed between Web experience and Bookmark organization. The modified model which allowed Web experience to directly predict Bookmark organization had an adequate fit: $\chi^2 (69, N = 600) = 126.26$ and the other fit indices are good (see Table 6 for fit indices) and it was not significantly different from the initial measurement model: $\chi^2 \text{ diff}(1) N = 600) = 0.04$. This final model was considered to represent the pattern of covariations between factors as well as the measurement models. The final model is depicted in Figure 1. Thirty-three percents of the variance of Bookmark organization and 41% of the variance of Web ability were explained in this model.

Insert Figure 1 about here

Communality Estimates

In order to determine predictive variance in Web ability that was unique to and shared among the other predictors, a communality analysis was performed in the latent space (Hertzog, 1989; Pedhazur, 1982), by allowing the combinations of age and Web experience to predict Web ability.

As seen in Table 7, out of the 41% variance accounted for by the model, age uniquely explained only 7% of the variance while Web experience uniquely accounted for 27% of the variance. Seven percent of the variance was shared by age and Web experience.

Next, the contribution of age and Web experience to Bookmark organization was computed. The largest contribution to Bookmark organization was the unique contribution of Web experience: 13%, as observed from Table 7 and shared with other variables Web experience explained a total of 28% of the variance in Bookmark organization. Age effect was fully mediated by Web ability, although shared with other variables age indirectly contributed a total of 11% of the variance in Bookmark organization.

Insert Table 7 about here

4. DISCUSSION

The current study attempted to examine the relationships between Bookmark organization, age, Web experience, and Web self-rated ability. The pattern of correlational relationships between age and the Web-related variables was congruent with our expectations. Specifically, negative age-related differences were evident for the measures of Web self-rated ability and that Web experience was positively related to Web ability. The finding is congruent with previous studies which also found increased age associated with lower Web ability (Breakwell & Fife-Schaw, 1988; Henderson et al, 1995) and higher Web or computer experience led to higher Web or computer ability (Czaja & Sharit, 1993a, b; Jay & Willis, 1992).

In previous studies, the organization of personal information space (such as links, bookmarks, hotlists, etc) had been observed to be strongly related to the level of expertise or level of ability, either in general world (e.g. Schvaneveldt et al, 1985) or in the Internet world (e.g. Patel, Drury & Shalin, 1998). The same trend was observed in the present study where Web ability and Bookmark organization has a positive correlation of coefficient of 0.45, indicating that the higher the level of ability, the more manipulations the users do to organize their bookmarks. Similarly, previous studies had found a strong link between

experience and personal information space organization (e.g. Carr, Hall & Hitchcock, 1998), which was also observed in the present study as a significant positive direct link (0.18) as well as mediated through Web ability. Again, the positive correlation suggested that the more experienced the users are, the more bookmark organization were performed. The results are in conformance with Thomas and Fischer's (1997) and Halio's (1992)' suggestion, that as the Web grows and the user's expectations of the information they could get from the Internet follow to grow, the users would realize that until navigational aids are perfected by hypertext and multimedia designers, keeping their personal information space manageable is the only way to meet their own expectations.

The finding of the present study that the effect of age on bookmark organization was mediated by Web ability was in line with our hypothesis and at the same time had a great implication. That is, contrary to the belief that old people are less effective and capable in using the Web or organizing their personal information space, the present study found that age was not a direct factor affecting the way the Web users organize their personal information space. By improving the level of Web ability, even older users would perform in similar way as their younger counterparts in organizing their personal information spaces.

Results from the structural equation modeling indicated that both Age and Web experience were strong predictors of Web ability, accounting for 41% of the variance. In addition, follow up communality analysis, which parsed the explained variance in Web ability into unique and shared components, provided a cleared indication of the predictive salience of age and Web experience. In combination, Web experience and age accounted for significant proportion (41%) of the overall explained variances in Web ability. However, Web experience accounted for more than three times the variance in Web ability than accounted for by age (Web experience uniquely accounted for 27% of the variance while age uniquely explained only 7% of the variance). This is an interesting finding because it suggested that by facilitating a proper mean to improve Web experience (such as providing training adapted to take into account older users' needs) would have a bigger impact in improving Web ability than the decline in Web ability caused by age. Previous studies have suggested similar results (Birdy, Pennington & Zapf, 1997; Baldi, 1997, Kelley & Charness, 1995).

Although personal information organization is an important aspect in Web organization because it reflects how users categorized the Web, surprisingly not many studies about what factors contributed to the way the users managed their bookmarks had been found. The present study indicated that the strongest single indicator of bookmark organization is Web experience which directly affects bookmark organization (13%) as well as mediated through Web ability (7%). Age effect was much less than Web experience, indicating that age was not as big a factor as Web experience to affect bookmark organization. Again, the result points out that, the less effort in bookmark organization is not largely due to the increase in age but more due to lack of both Web experience and Web ability.

Note that due to the cross-sectional nature of this study, statements regarding causality among the hypothesized factors can not be made. Instead, the identified pattern of predictive relationships should be considered as a first step in determining the relationships among Bookmark organization, Web ability, age and Web experience.

The limitations of using a convenience sample should be acknowledged. This data was analyzed with the data from Project 2000 that contain "more long-term, sophisticated computer users than the general population" (Hoffman & Novak, 1996, p. 36). In addition, because of the over-sampling of older subjects, this sample would not exactly represent the general population of Web users.

The implications of the findings in the current study are that with proper training to accommodate the needs of older users would ensure that the older users would pick up the same Web ability as their younger counterparts that would in turn affect the way they organize their personal information space. The result also suggested that the stereotype opinions that older adults are less likely to master the Web and to organize their bookmarks was not entirely true. This finding suggested that there is a great need to

put more efforts in training older users to gain more experience on the Web in order to improve their Web ability, which will lead to effective bookmark organization.

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Table 1

List of questions and the correlation between observed and latent variables of Web ability

Web Ability	Questions
0.83***	3. I am very skilled at using the Web.
0.69***	24. I know how to find what I want with a search engine.
0.68***	34. Downloading software is easy for me to do on the Web.
0.85***	38. I consider myself knowledgeable about good search techniques on the Web.
0.82***	40. I know more about using the Web than most users.
0.71***	44. I find the Web easy to use.
0.69***	67. When I encounter a problem using the Web, I get stuck because I don't know what to do next vs. the Web isn't as challenging to me as it used to be.
0.82***	68. clearly know the right things to do vs. feel confused about what to do.

Note: *** = $p < 0.001$

Question 67-68 asked the subjects how they feel when they use the Web.

Table 2:

List of questions and the correlation between observed and latent variables of Bookmark organization

Bookmark organization	Questions
0.69***	1. Create a new entry.
0.80***	2. Manually re-arrange entries.
0.75***	4. Create sub folders within folders (hierarchy).
0.74***	6. Annotate an entry.

Note: *** = $p < 0.001$

Table 3
Demographics groupings by age (N=600)

	Age						Cases	%
	18-24	25-34	35-44	45-54	55-64	65+		
Gender								
F	16	49	50	41	24	10	190	31.7
M	53	110	68	72	61	46	410	68.3
Education								
Less than high school	0	1	0	0	1	1	3	0.5
HS graduate	2	8	5	8	9	5	37	6.2
Some college	41	51	34	36	26	15	203	33.8
Completed college	21	60	35	22	14	9	161	26.8
Some postgraduate	3	12	7	13	9	6	50	8.3
Grad/Prof. Degree	2	27	37	34	26	20	146	24.3
Marital Status								
Divorced	1	5	16	17	13	4	56	9.3
Married	10	86	75	77	65	42	355	59.2
Separated	0	2	2	5	1	0	10	1.7
Single	58	66	25	12	4	5	170	28.3
Widowed				2	2	5	9	1.5
Race								
Asian	2	3	1	0	0	1	7	1.2
Black	0	0	0	0	1	0	1	0.2
Hispanic	4	3	1	1	1	0	10	1.7
Other	4	4	4	4	0	0	16	2.7
White	59	149	112	108	83	55	566	94.3
Occupation								
Professional	6	33	35	48	26	14	162	27
Support	1	7	13	7	3	1	32	5.3
Technical	17	48	26	16	6	5	118	19.7
Student	31	12	1	1	0	0	45	7.5
Other	14	54	37	33	26	11	175	29.2
Not working		5	6	8	24	25	68	11.3

Table 4
Web ability and Bookmark organization distributions by age (N=600)

Age Groups	Web ability Mean (S.D.)	Bookmark organization Mean (S.D.)	Cases
18-24	3.30 (.69)	2.90 (1.42)	69
25-34	3.11 (.66)	2.67 (1.53)	159
35-44	2.83 (.73)	2.12 (1.62)	118
45-54	2.80 (.68)	2.37 (1.59)	113
55-64	2.67 (.70)	1.93 (1.65)	85
65+	2.48 (.81)	1.84 (1.62)	56
All subjects	2.90 (.74)	2.35 (1.60)	600

Table 5

Bivariate Correlations between Web Ability, Web Experience and Age (N = 600)

	ABILITY	BOOKMARK	EXPERIENCE	AGE
ABILITY	1	0.39***	0.48***	-0.36***
BOOKMARK	0.56***	1	0.41***	-0.20***
EXPERIENCE	0.59***	0.45***	1	-0.24***
AGE	-0.37***	-0.22***	-0.23***	1

Note: The values above the diagonal represent correlations between the summed scores.
The values below the diagonal represent correlations between the constructs.

Table 6

Nested Comparison of Model Fit for Prediction Models (N = 600)

Model Step	χ^2	df	Comparison to Measurement Model			Comparison to Previous Model		
			χ^2	df	p	χ^2	df	p
Measurement model	126.22	68						
Hypothesized model	139.54	70	13.3	2	0.00			
Final model	126.26	69	0.04	1	1	13.28	1	0.00

Table 7a

Unique and Shared Variance Estimates for Age and Web Experience predicting Web Ability (N = 600)

Component	Variance explained (%)
Unique Age	7
Unique Web Experience	27
Shared Age and Web Experience	7
Total variance explained	41

Table 7b

The effect of Age and Web Experience predicting Bookmark organization (N = 600)

Component	Variance explained (%)
Unique Web experience	13
Unique Age	0
Unique Web ability	2
Shared age and Web experience	0
Shared age and Web ability	3
Shared Web experience and Web ability	7
Shared age, Web experience and Web ability	8
Total variance explained	33

Figure Captions

Figure 1. The final best fitting structural model, with standardized regression weights.

