Impact of Prior Knowledge and Computer Interface Organization in Information Searching Performances: A Study Comparing Younger and Older Web Users

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Abstract. The present study addressed age-related differences in performance to find information by older and younger web users. More precisely, we determined the impact of prior domain knowledge (high level *vs* low level) of older and younger adults and the interface organization (taxonomical-HS *vs* tag-based organization-TBS) on information search performance. The main results showed that older users exhibited poorer information searching performance than the younger users only for Manga domain (for which the younger users had higher level of knowledge than the older ones). For the two domains, the TBS interface decreased age-related differences in performance. In contrast, the HS interface generated lower performances for the older adults in the two domains, especially faced to Manga domain in which older users had very lower performances than younger users.

Keywords: Information searching; aging; taxonomy organization *vs* tag-based organization; knowledge-domain.

1 Introduction

Since the 1990s, the number of websites has increased extensively, and older adults are shown to be one of the fastest growing demographic groups of web users that profit from the wide ranges of Internet services to search for information and communicate [9, 10]. However, various studies show that older people experience more difficulties than younger people in using such systems (for a recent review, see [11]). These difficulties may be exacerbated if the interface organization does not fit the users' cognitive specificities.

In a previous study, Pak and Price [5] instructed older and younger adults to search for travel information (domain for which older and younger adults had about the same knowledge) on two systems varied in their organization:

- A hierarchically organized system (HS), which maintained a one-to-one relationship between menu link and page.

- A tag-based system (TBS), with a many-to-one relationship between menu and page.

These authors observed that younger adults obtained better search performance than older adults. However, the TBS interface reduced age-related differences, as compared with a HS interface. The older adults could benefit from their higher vocabulary skills compared to younger adults in the TBS interface. Whereas the HS interface required more spatial abilities, therefore the younger adults, who had higher spatial abilities than older ones, could navigate it easier than the older adults. In their study, the young and old participants had the same level of knowledge in travel domain. So if older adults have more knowledge of a domain than younger adults, their performance in a TBS interface should be increased, and even greater than the younger adults.

Many studies focused on the role of prior knowledge on comprehension of hypertext systems (for reviews, see [1, 2]). In contrast, very few studies addressed the impact of prior domain-knowledge on the information searching activity as well as strategies carried out by individuals. These studies were carried out with young users, and frequently with students in various domains (e.g., [4, 6]).

To contribute to this topic, we carried out a new experiment in which we studied the role of prior domain knowledge on information searching performance of older and younger adults according to the interface navigated (HS *vs* TBS).

2 Method

2.1 Participants

20 younger adults (M=20.6 years, SD=1.7) and 20 older adults (M=73.43 years, SD=6.23) participated at this experiment. All participants were volunteers, in good health, and had normal or corrected-to-normal vision. The younger participants were students. The older participants were retired individuals. They lived in their own home, and did not need any assistance to perform daily activities. Older participants all scored over 27 (M=29.65, SD=0.67) on the Mini-Mental State Examination [3], which means that they had no cognitive impairment.

2.2 Materiel and Procedure

All the participants were instructed to search for information to answer 20 questions in a hierarchically organized system (HS), and a tag-based system (TBS) (10 questions per domain), providing information related to two domains:

- Manga domain for which younger participants had higher level of prior knowledge than the older participants (M_{young}=5.9, SD_{young}=1.2 *vs* M_{old}=3.6, SD_{old}=1.9; t(34)=3.941, p<.0005).
- Banking and insurance domain for which older participants had higher level of prior knowledge than the younger participants (M_{old}=5.9, SD_{old}=1.4 *vs* M_{young}=3.75, SD_{young}=1.5; t(34)=-3.671, p<.001).

In line with Pak and Price's study, for instance, in the HS interface of Manga, the page concerning "weekly preprint" could be located in four steps (four linked required to be clicked): (1) Manga marketplace, (1.1) Manga literacy marketplace, (1.1.1) Professional publications and (1.1.1.1) Weekly preprint. In contrast, in the TBS interface, the first three levels of links (1, 1.1, and 1.1.1) were displayed in alphabetical order. In the TBS, the participant could find correct answer from the previous three links and then open the fourth link (1.1.1.1); that corresponded to two steps. TBS explicitly allows information to have multiple keywords, resulting in an increased probability that a particular keyword generated by the participant is linked to the desired information.

2.3 Variables

A Latin square of three independent variables were designed: Age (young, old), interface organization (HD, TBS) and domain knowledge (Manga, Banking-Insurance).
We computed the two following measures of performances:

- A composite score of giving up and incorrect responses. Lower values indicated better performance.
- The task time (in sec.) needed to find the answer. As in the HS the participants required two steps more than the TBS interface, we computed a mean time to open a link, which we subtracted (for two links) from the initial task time.

3 Results

All results are presented in Table 1.

3.1 Composite Score of Giving Up and Incorrect Response

For the Manga domain, the ANOVA did show that older users exhibited poorer performance than the younger ($F(1,36)=17.612$, $p<.001$, $\eta_p^2=.33$). The interface had a significant effect ($F(1,36)=10.783$, $p<.005$, $\eta_p^2=.23$): the TBS interface generated better performance than the HS. The Age × Interface interaction had also a significant effect ($F(1,36)=11.975$, $p<.005$, $\eta_p^2=.25$). As expected, the younger participants had higher performance than the older participants when they dealt with the HS interface ($F(1,36)=29.317$, $p<.0001$) while no significant difference between the older and younger participants appeared for the TBS interface.
For the Banking-Insurance domain, the statistical analyses did not show any significant effect of the participants' age ($F(1,36)<1$, n.s.). On contrary, the interface had a significant effect ($F(1,36)=9.322$, $p<.005$, $\eta_p^2=.21$): the TBS interface generated better performance than the HS interface. The interaction between the age and interface was not significant ($F(1,36)=2.925$, $p>.05$).

3.2 Task Time

For the Manga domain, the age has a significant effect ($F(1,36)=37.242$, $p<.0001$, $\eta_p^2=.51$): the younger participants took less time than the older participants. The

interface had also a significant effect $(F(1,36)=5.177, p<.05, \eta_p^2=.13)$: the HS interface took longer than the TBS interface. The interaction between age and interface was not significant $(F(1,36)=2.717, p=.11)$.

For the Banking-Insurance domain, the age had a significant effect $(F(1,36)=30.466, p<.0001, \eta_p^2=.46)$: the younger needed shorter time than the older participants. The interface had no significant effect $(F(1,36)<1, n.s.)$. The interaction between age and interface was not significant $(F(1,36)<1, n.s.)$.

Table 1. Mean (SE) values for the number of composite score of performances, task time (in sec.) according to age group, the interface and the domain

Dependant variables		Manga		Banking-Insurance	
		TBS	HS	TBS	HS
Performance (composite score)	Younger participants	-0,35 (0,9)	-0.39 (0.61)	-0.39 (0.09)	-0.11 (0.2)
	Older Participants	-0.16 (1.18)	1.52 (1.56)	-0.48 (0.07)	0.36 (0.26)
Task time (in sec.)	Younger participants	35,33 (5,38)	40,35 (4,93)	33,65 (4,44)	29,95 (4,49)
	Older Participants	70,96 (7,64)	102,35 (12,01)	65,84 (6,27)	72,19 (10,13)

4 Conclusion

In conformance with prior works [9, 11], the results showed that the older adults took longer to find information than the younger adults regardless of the interface and the domain. More precisely, in the Banking-Insurance domain, although the younger participants took less time than the older participants regardless of the interface, these two age groups obtained close performance. Indeed, the older participants had better performance while they navigated the TBS interface than the HS interface, although they took approximately the same time in to two interfaces. The older adults may need high reflexive time before making decision when they had high level of prior domain-knowledge. This result corroborated Starns and Ratcliff's finding [7]: the younger adults attempt to balance speed and accuracy to obtain better performance, whereas older adults attempt to reduce errors by finding information more slowly.

The age-related differences in performance (composite score of giving up and uncorrected answer) was significant only for the Manga domain, especially in the HS interface, for which the older participants had lower level of knowledge than the younger participants.

For the two domains, the TBS interface decreased age-related differences in performance. In contrast, the HS interface generated lower performance for the older adults in the two domains, especially faced to Manga domain in which older users had very lower level of knowledge than younger users.

Based on these findings, two points are relevant to be considered for web designers:

- A tag-based interface supports older users in finding information. A tag-based organization should be used to facilitate the navigation, especially the older users' navigation.

- Although the prior knowledge level also has an important impact on information searching activity and allows decreasing age-related differences, the TBS facilitated the navigation of older participants.

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