Does Web Design Matter? Examining Older Adults' Attention to Cognitive and Affective Illustrations on Cancer-Related Websites through Eye Tracking

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Abstract. This study examines how adults pay attention to cognitive and affective illustrations on a cancer-related webpage and explores age-related differences in the attention to these cognitive and affective webpages. Results of an eye-tracking experiment (n = 20) showed that adults spent more time attending to the illustrations on the cognitive webpage than the illustrations on the affective webpage. Furthermore, older adults spent about 65% less time fixating the webpages than younger adults. Whereas older adults had less attention for illustrations on the cognitive webpage then younger adults, they spent equal time viewing the illustrations on the affective webpage as younger adults.

Keywords: eye tracking, aging, attention, fixation duration, cancer-related information, cognitive and affective illustrations, e-health.

1 Introduction

The Internet offers a viable source for disseminating cancer information and is increasingly used by cancer patients. Many hospitals also refer their patients to information on the Web, such as patient portals and hospital websites. Hence, a lot of cancer-related information is presented online and sometimes even exclusively online [1]. Even though older adults use the Internet progressively more [2], including for health information [3], this does not necessarily mean that they understand online cancer information. The ability to seek, find, and understand cancer information from electronic sources is markedly lower among older adults [4]. This might be a result of, among other things, declines in older adults' basic abilities, such as cognitive (e.g., decreased working memory) and sensory (e.g., decreased visual acuity) modalities [5].

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To make online cancer information more understandable for older adults, illustrations can be added with the aim to expand cognitive capacity. Older adults often have a smaller total cognitive capacity than younger adults and would therefore benefit more from having online information presented in multiple formats, such as text and illustrations [6]. However, we currently lack knowledge on how older adults use illustrations on cancer-related websites and whether different types of illustrations are differently used. We distinguish between cognitive illustrations (i.e., images that complement text and help people to understand it) and affective illustrations (i.e., images that mainly aim to evoke positive feelings and to generate positive emotions). Whereas cognitive illustrations are expected to increase understanding and recall of information through expanding people's cognitive capacity, affective illustrations might increase these outcomes in a different way. According to the socioemotional selectivity theory, older adults have more emotion-related goals and use these goals to encode and memorize information [7]. As a result, older adults are expected to spend more time to affective illustrations and consequently recall this information better. This is called the positivity effect and might explain a greater attentional focus of older adults on affective information [8].

Previous empirical research has shown both positive effects (e.g., increased website satisfaction and recall of information) of adding cognitive and affective illustrations to text information [9], [10] as well as no or mixed effects of adding such illustrations (e.g., increased recall of information but only for younger adults) [11], [12]. More insight into how older adults use cognitive and affective illustrations can help to understand these differences. Using eye-tracking data, we therefore aim to (a) examine how adults pay attention to cognitive and affective cancer-related webpages and (b) explore possible age-related differences in attention to cognitive and affective webpages.

2 Method

2.1 Stimulus Material

We created two English versions of a cancer-related webpage that modeled the website of the Netherlands Cancer Institute (NKI). The Dutch version of the webpage was used in previous studies [11], [12]. This specific webpage contained information on Radio Frequency Ablation (RFA) treatment, which is a minimally invasive treatment to treat metastases in the lung. The content of the text information was kept constant across the two versions of the webpage. The only difference between the webpages was the figures: In one version, two cognitive illustrations were included on the webpage and in the other version, two affective illustrations were included on the webpage. Illustrations were extensively pre-tested in two previous studies in order to choose the most appropriate cognitive and affective illustrations [11], [12]. The webpages used in this study are presented in Figures 1 and 2 respectively.

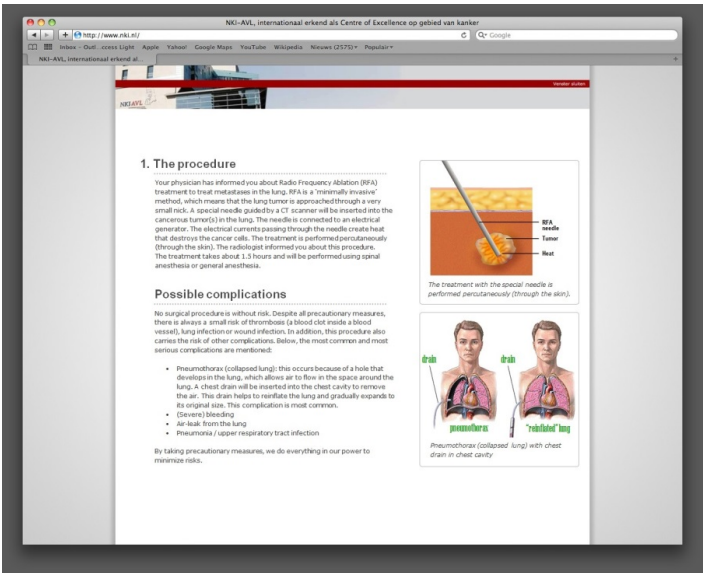

Fig. 1. The webpage containing RFA information and cognitive illustrations

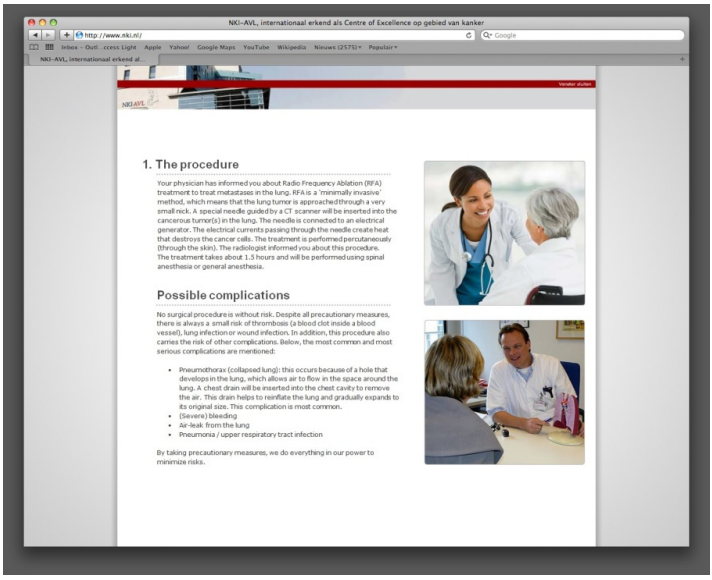

Fig. 2. The webpage containing RFA information and affective illustrations

2.2 Participants and Procedure

Participants were residents of the metropolitan Washington, DC area. Ten younger adults (aged 23-33, M = 26.50, SD = 2.88) and ten older adults (aged 51-70, M = 58.80, SD = 6.55) participated in the study. Participants completed a screener questionnaire prior to participation. We were therefore able to create two equal experimental conditions that included both younger and older adults. The two experimental conditions did not significantly differ with regard to the participants' age, $F(1, 18) = 0.00$, $p = .990$, $\eta^2 = .00$, education level, $\chi^2 = 1.11$, $p = .774$, gender, $\chi^2 = 0.20$, $p = .655$, and Internet use, $F(1, 18) = 0.26$, $p = .616$, $\eta^2 = .01$.

Eligible participants were invited to the usability lab where the study took place. Each participant sat individually behind a 21.5 inch monitor that had a Tobii X2-60 eye tracker attached to it (see Figure 3). Each session started with the moderator reading instructions about the study followed by the eye-tracker calibration. Instructions made clear that participants could look at the webpage as long as they preferred and that no navigation or search task was needed because the webpage was a snapshot of a webpage. Calibration involved the participant looking at five predefined points on the screen. After calibration, participants were exposed to one version of the webpage. Upon completion of the study, participants received 15 USD for their participation.

Fig. 3. Participant viewing one version of the webpage in the usability lab

2.3 Data Analysis

Eye-tracking data were prepared and exported to SPSS using Tobii Studio software. Heat maps were generated using the same software to visualize results. Areas of Interest (AOIs) were defined to assess the time (duration in seconds) that participants fixated the text and illustrations. We conducted Analyses of Variance (ANOVAs) to measure differences in fixation duration between cognitive and affective illustrations, to explore differences between the younger and older age group, and to examine age-related differences within the two experimental conditions.

3 Results

3.1 Attention to the Webpage

The eye-tracking data were analyzed to determine how much time participants fixated the cognitive webpage and the affective webpage, overall. Participants spent on average 63.65 seconds viewing the full webpage (SD = 41.85). We examined the illustrations AOI for the cognitive webpage and the affective webpage and found that across all participants, there were significant differences in fixation duration between the cognitive and affective illustrations, $F(1, 16) = 23.46$, $p < .001$, $\eta^2 = .59$, such that people spent more time on the cognitive illustrations (M = 12.12, SD = 9.24) than the affective illustrations (M = 1.25, SD = 1.38). No differences were found in fixation duration for the text when comparing the cognitive webpage and the affective webpage, $F(1, 16) = 0.04$, $p = .838$, $\eta^2 = .00$.

3.2 Age-Related Differences in Attention to the Webpage

Next we examined age-related differences in attention to the webpage and found that older adults spent significantly less time fixating the webpages compared to younger adults, $F(1, 16) = 22.09$, $p < .001$, $\eta^2 = .58$. Whereas younger adults spent on average 93.83 seconds viewing the webpages (SD = 36.47), older adults only spent 33.47 seconds on average viewing the webpages (SD = 18.55), indicating that older adults spent almost 65% less time viewing the webpages than younger adults (Table 1).

Table 1. Fixation duration (in seconds) stratified by condition and age group (n = 20)

		Fixation duration on the webpage		Fixation duration on the text		Fixation duration on the illustrations	
	n	M	SD	M	SD	M	SD
Cognitive illustrations	10	70.72	46.67	57.24	36.06	12.12	9.24
Younger adults	5	107.49	30.78	87.85	26.45	18.26	8.84
Older adults	5	33.96	19.13	26.63	14.75	5.98 [b*]	4.46
Affective illustrations	10	56.57	38.75	54.70	38.42	1.25 [c***]	1.38
Younger adults	5	80.17	39.72	77.34	40.50	2.06 [d***]	1.57
Older adults	5	32.97	20.20	32.07	20.02	0.44	0.41
Total	20	63.65	41.85	55.97	37.25	6.69	8.51
Younger adults	10	93.83	36.47	82.59	32.72	10.16	10.42
Older adults	10	33.47[a***]	18.55	29.35[a***]	16.82	3.21[a**]	4.18

Note. The higher the fixation duration the more attention was paid to (elements of) the webpage. M = Mean; SD = Standard Deviation.

[a]Mean differs significantly compared to younger adults. [b]Mean differs significantly compared to younger adults in the cognitive illustrations condition. [c]Mean differs significantly compared to the cognitive illustrations condition. [d]Mean differs significantly from younger adults in the cognitive illustrations condition. * $p < .05$. ** $p < .01$. *** $p < .001$.

Next we examined age-related differences to the AOIs (text and illustrations). We found that older adults spent significantly less time fixating the text information (M = 29.35, SD = 16.82) than younger adults (M = 82.59, SD = 32.72), $F(1, 16) = 19.16$, $p < .001$, $\eta^2 = .55$, across both webpages, $F(1, 16) = 19.16$, $p < .001$, $\eta^2 = .55$. This is depicted in the mean fixation duration heat maps shown in Figure 4 (cognitive webpage) and Figure 5 (affective webpage). We also found a significant webpage × age interaction, $F(1, 16) = 5.64$, $p = .030$, $\eta^2 = .26$, such that younger adults attended to the cognitive illustrations more than older adults, $F(1, 17) = 6.45$, $p = .021$, but there was no difference in attention to the illustrations for older adults (shown in Figure 6). Moreover, younger adults attended more to the illustrations on the cognitive website than to the illustrations on the affective website, $F(1, 17) = 17.31$, $p = .001$ (shown in Figures 4 and 5). Fixation duration results are shown in Table 1 and Figure 7.

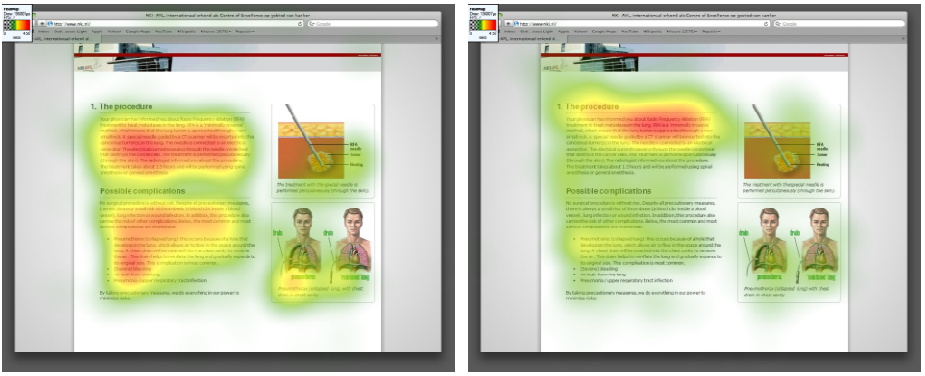

Fig. 4. Mean fixation duration heat maps for the cognitive website for younger (left) and older (right) participants

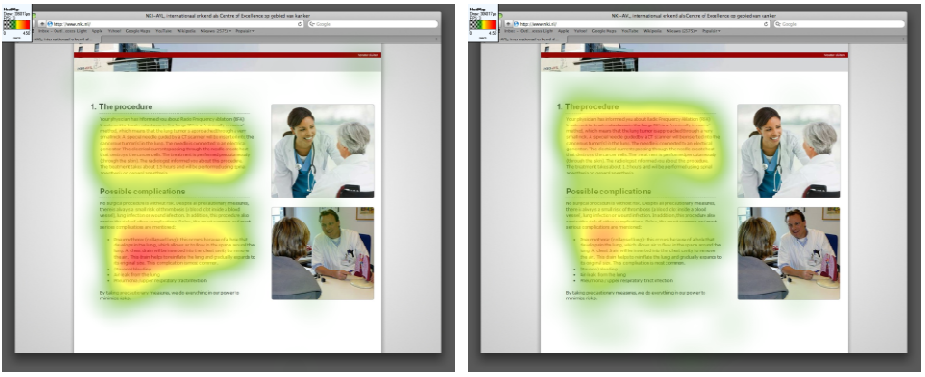

Fig. 5. Mean fixation duration heat maps for the affective website for younger (left) and older (right) participants

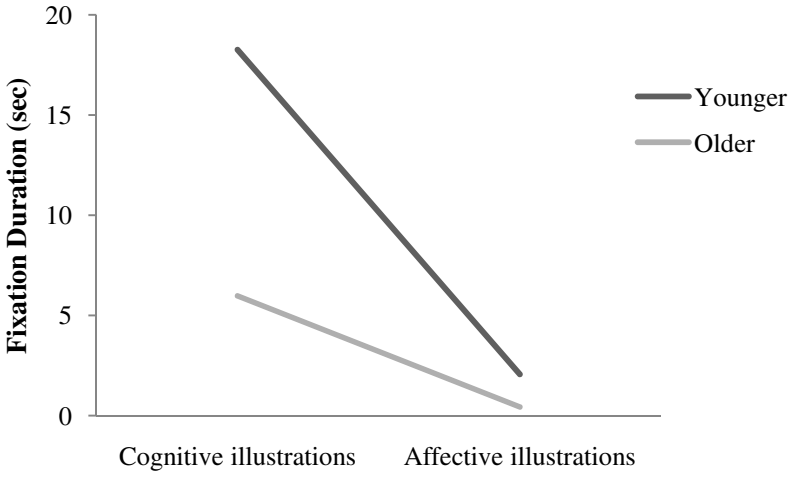

Fig. 6. The interaction effect between type of webpage and age on fixation duration to the illustrations on the cognitive and affective webpage

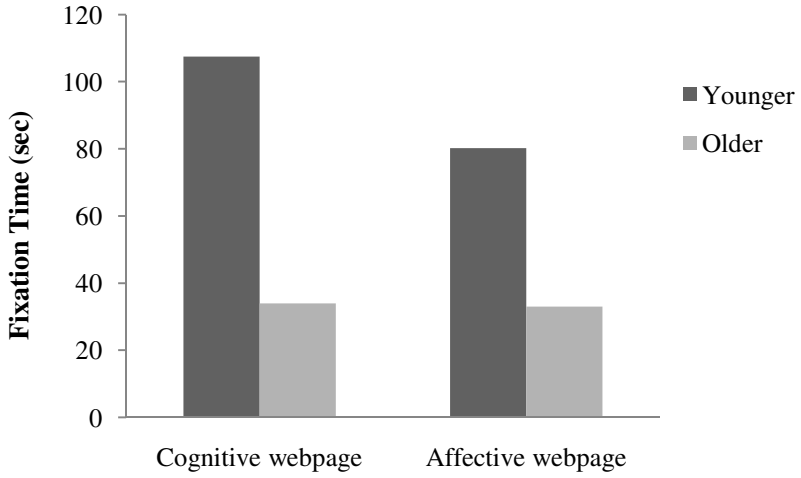

Fig. 7. Mean fixation duration for viewing the cognitive and affective webpages stratified by age group

4 Conclusion and Discussion

In this eye-tracking study, we examined how adults attend to cognitive and affective cancer-related webpages and how younger and older adults differ in their attention to such webpages. We found that overall, participants attended more to the illustrations on the cognitive webpage than on the affective webpage, and attention to the text information was equivalent across both types of webpages. When exploring age-related differences, we found that older adults spent 65% less time viewing the webpages than younger adults did. As a consequence, older adults also spent less time reading the text information than younger adults. With regard to the illustrations on the cognitive and affective webpages, we found that older adults fixated the illustrations on the cognitive webpage considerably less than younger adults. However, older adults spent an equal amount of time on the illustrations on the affective webpage compared to younger adults.

We had not expected that older adults would spend significantly less time viewing the webpage than younger adults. This is in contrast with other eye-tracking research in which older adults spent more time viewing webpages when they were instructed to complete a specific navigation task [13, 14]. An explanation could be that the task of this particular study was to view a snapshot of the webpage as long as the participant preferred rather than completing a navigation task. In our study, Internet experience might have played a less important role but might be a predictor of navigation task completion time [14], [15]. This low attention score among the older age group should however be considered as a related study revealed that attention to the text information increased recall of information, particularly in older adults [12]. Recall of information is a prerequisite for important health outcomes, such as adequate disease management [16] and adherence to medical regimes [17]. Future research should therefore focus on finding effective ways to motivate older adults to pay attention to cancer-related websites in order to optimize their recall of online cancer-related information.

Younger adults spent more time on the illustrations on the cognitive webpage than older adults whereas attention to the illustrations on the affective webpage was equal across younger and older adults. This is in line with the socioemotional selectivity theory stating that younger adults hold more knowledge acquisition goals which shift toward more emotional goals as they age [7]. This difference in motivational goals is reflected in the results and might explain the attention differences for the illustrations on the cognitive and affective webpage in younger and older adults.

This study provided new insights into the differences in younger and older adults' attention to cognitive and affective illustrations on cancer-related websites. Moreover, our results provide practical evidence for the socioemotional selectivity theory. However, as the age of the older adults in this sample started at 51 years old, we might have underestimated the attention to emotional information (i.e., the affective webpage in older age) since attention to emotional material increases even more after the age of 70 [7]. Nevertheless, this study shows that websites may need to be designed differently when older adults are the primary user group.

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