



## Full length article

## Effect of Web navigation style in elderly users



Diana Castilla<sup>a, c, \*</sup>, Azucena Garcia-Palacios<sup>a, c</sup>, Ignacio Miralles<sup>a</sup>, Juana Breton-Lopez<sup>a</sup>, Elena Parra<sup>b</sup>, Sergio Rodriguez-Berges<sup>a</sup>, Cristina Botella<sup>a, c</sup>

<sup>a</sup> Jaume I University, Av. Vicente Sos Baynat s/n. Labpsitec, Edificio de Investigación II. Labpsitec, Castellón de la Plana 12071, Spain

<sup>b</sup> Polytechnic University of Valencia, Camino de Vera s/n, Ciudad Politécnica de la Innovación, Cubo Azul – Acceso N. Edificio 8B, Valencia 46022, Spain

<sup>c</sup> CIBER of Physiopathology of Obesity and Nutrition CIBERobn, Edificio D 1° Planta, Hospital Clínico Universitario de Santiago de Compostela Choupana s/n, 15706 Santiago de Compostela, Spain

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## ABSTRACT

The population is gradually aging, but only 4% of elderly people are Internet users. These data indicate the need to take action to bridge this digital divide.

Several studies show that learning and memory processes are faster when there is familiarity with the learning object, and the user finds a clear internal correspondence between the previous experience and the current experience. The elderly make up one of the groups most affected by the digital divide, with less Internet access, knowledge, and use. The Internet is by definition an almost infinite structure of hypertext, where the user navigates by using information in an active way, and where the elderly lack previous experience with hypertextual applications. The aim of this study is to test the navigation variable by comparing two designs of the same email Web application with different navigation styles: linear vs hypertextual navigation.

The study consisted of usability testing, employing the method of task analysis. Other assessment tools were also used, such as the eye tracker and post-session self-report questionnaires designed ad hoc for this study.

A sample of 34 users from 60 to 83 years old and with heterogeneous previous experience with new technologies participated in the study. They performed A/B testing with a counterbalanced within-subject design. The linear navigation condition, compared to the hypertextual condition, obtained a higher success rate, lower performance time, better satisfaction ratings and greater user preference.

The main contribution of this study is to demonstrate the relevance of navigation in systems oriented toward the elderly, indicating that linear navigation is more suitable for these users.

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## 1. Introduction

In 1969 man conquered space and arrived on the moon, an amazing event in a world that used the radio for communications and where there were still very few black and white TVs in homes. However, in that same year another new frontier opened up quietly: cyberspace. ARPANET (Advanced Research Projects Agency

Network) connected four computers in a network, marking the beginning of the Internet. In 1993 there were 100 websites all over the world, and only 20 years later, there are around 14 billion websites and approximately 2.405 million users in the world (World Wide Web Size, 2013; Internet World Stats). At the same time, life expectancy has increased and, according to different reports (European Commission, 2006; United Nations, 2009), in 2009 one out of nine people were over 60 years old. Although the proportion of elderly people is growing, the reality is that they are the age group with the least presence in the Internet. According to a European Commission report (2010), only 4% of elderly people are Internet users. In sum, on the one hand, society is increasingly influenced by Information and Communication Technologies (ICT) and, on the other, there is an aging population with no expertise or experience in the use of ICT.

\* Corresponding author. Jaume I University, Av. Vicente Sos Baynat s/n. Labpsitec, Edificio de Investigación II. Labpsitec, Castellón de la Plana 12071, Spain.

E-mail addresses: [castilla@uji.es](mailto:castilla@uji.es) (D. Castilla), [azucena@uji.es](mailto:azucena@uji.es) (A. Garcia-Palacios), [mirallei@uji.es](mailto:mirallei@uji.es) (I. Miralles), [Breton@uji.es](mailto:Breton@uji.es) (J. Breton-Lopez), [eparra@labhuman.i3bh.es](mailto:eparra@labhuman.i3bh.es) (E. Parra), [berges@uji.es](mailto:berges@uji.es) (S. Rodriguez-Berges), [botella@uji.es](mailto:botella@uji.es) (C. Botella).

Several studies indicate that learning and memory processes are faster when there is familiarity with the learning object and the user finds a clear internal correspondence between the previous experience and the current experience (Graf & Mandler, 1984; Mandler, 1980, 1991). That is, studying the user's mental model, as well as his/her previous experiences, and implementing them as part of the interaction, strengthens the user's final experience, improving learning time and satisfaction with the user experience. However, elderly people's previous experience is mostly related to analog references. Regarding the hypertext structure, there is evidence about disorientation during navigation (Kim & Hirtle, 1995) and this disorientation can impair performance and learning (Puerta Melguizo, Lemmert, & Van Oostendorp, 2006). Puerta Melguizo et al., 2006 stated that it is important to take into consideration ergonomics recommendations to reduce the involvement of executive functions that decline with age in the use of a website by the elderly. The elderly make up one of the groups most affected by the digital divide, with less Internet access, knowledge, and use (Karahasanovic et al., 2009). Even when they have access to the technology they encounter barriers like frustration, mistrust, and physical and mental limitations (Gatto & Tak, 2008). In general, ICT has adopted standards that are suitable mainly for middle-aged and young people (Sloan, 2006). But what happens to those who are disconnected?

Several studies indicate that, under controlled use conditions, the elderly show a higher number of usability problems than young people (Nielsen, 2002). Studies also state that by improving the usability of the system, the efficiency of all users also improves (both young and older users) (Chadwick-Dias, McNulty, & Tullis, 2002). Coyne and Nielsen (2002) found that users over 65 years old are 43% slower in the use of websites than younger users (between 21 and 55 years old).

According to Chadwick-Dias et al. (2002), there is a clear correlation between experience with computers and general performance. However, even when controlling the variable "experience with PCs", older people's performance was worse. In a later study, Chadwick-Dias, Tedesco, and Tullis (2004) found that, despite the fact that experience with computers correlates with performance, the best predictor of performance is age, independently of experience. In other words, the differences between young people and the elderly cannot be explained only by previous experience with technology. These results open up a wide range of possible explanations, where it would be important to take into account other emotional or cognitive processes that could be involved in the interaction with technology. For example, the results of a study carried out by Gomez, Egan, and Bowers (1986) indicate that changes in spatial ability in the elderly could be in part the cause of a reduced performance in computer tasks for these users. Another example, Dommes, Chevalier, and Lia (2011) indicate that cognitive flexibility is an important factor, especially in situations where users reach a deadlock in the search for information on the Web. In this case, older users (with lower cognitive flexibility due to natural cognitive decline) obtained worse results.

The elderly find it more difficult to use ICT, and when they use them, their success rate is lower. The usability problems belong to different levels, from the design of the graphical user interface to the use of the most common computer peripherals. For example, the use of the mouse, a widely extended peripheral, can be very difficult for these users (Dickinson, Newell, Smith, & Hill, 2005; Hawthorn, 2005). These ICT difficulties that the elderly encounter in general can also be observed in the use of Web sites, where elderly users have more problems than other categories of users (Bernard, Liao, & Mills, 2001; Chadwick-Dias et al., 2002, 2004;

Fidgeon, 2006; Nielsen, 2002).

Several authors highlight that the problem goes beyond the graphical appearance or the text label nomenclature. According to Rosello (1997), the lack of familiarity with hypertext can provoke frustration and fear of getting lost in cyberspace. The sense of losing control over the general structure can produce fear of not being able to go back to the former place. Moreover, the elements of hypertext (hyperlinks) can generate difficulties in managing information. Lin (2003) showed evidence of how the navigation structure in elderly users can affect performance, finding that these users obtained better results using hypertext with a organized hierarchy than hypertext without a defined structure. Fukuda and Bubb (2003) compared the results obtained by young versus elderly people on a task consisting of finding a specific Web element. Using an eye tracker, these authors found that the use of hyperlinks was a difficult task for the elderly, given that they used their own navigation strategy, showed difficulties in remembering and organizing the sites they had visited, and took more steps in solving the task than the younger users.

The elderly have acquired knowledge through analog media that present information in a linear way (books), where the user's intervention does not vary the content. That is, the user is not responsible for organizing the information, but instead merely uses it in the order in which the author has arranged it. However, the hypertextual model means that the user has to make multiple decisions that will change the content of the information while he/she uses and organizes it. In hyperspace, the user becomes an active subject who reconstructs the information while it is being used.

Salmerón, Cañas, Kintsch, and Fajardo (2005) look more closely at the treatment of information, finding that its organization (linear vs. hypertextual navigation) changes the reading strategies used, and this in turn can indirectly influence the understanding of the content. These results indicate that hypertext could represent a problem that not only affects the recollection and organization of the information, but also its understanding.

In the same line, Madrid, Van Oostendorp, and Puerta (2009), stated that the process of choosing a link requires extra cognitive resources in comparison to linear Reading.

In addition, Sayago and Blat (2010) conducted an ethnographic study about how the elderly use email. The results indicated that the cognitive load linked to digital tasks (remembering the steps of the task, relating icons with functions, saving attachments, remembering where to go, etc.) is the most significant accessibility barrier for the elderly user.

From the point of view of the usability design of a system for the elderly, we believe that simplifying the graphical appearance, increasing the size of the icons and the text, and simplifying the graphical interface, among others, are basic and necessary design characteristics that would obviously improve the accessibility and usability of the system (Castilla et al., 2013). However, these actions might not be sufficient to make a system comprehensible for an individual who has never used a computer. For these users, the ease-of-use issue goes beyond making the system accessible or easy to use. They have to learn to use the system while learning what the Internet is and what they can do in this new context. Given these premises, the system not only has to be easy for these users, but also didactic.

This argument takes us back to the starting point: Given that the Internet is by definition an almost infinite structure of hypertext, where the user navigates through information in an active way and where the elderly lack previous experience with hypertextual applications, how does the navigation style influence the usability of a system for the elderly?

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