Human-Computer Interaction with Older People: From Factors to Social Actors

Sergio Sayago Barrantes

TESI DOCTORAL UPF / 2009

DIRECTOR DE LA TESI

Dr. Josep Blat (Departament de Tecnologies de la Informació i les Comunicacions)

UNIVERSITAT POMPEU FABRA

This work is dedicated to Say.
You will always be with me, wherever I am.

Agradecimientos

Cinco años atrás (o seis o siete, ya no me acuerdo de cuando empecé) nunca imaginé que algún dia fuera capaz de escribir una tesis doctoral. Y mucho menos la página de agradecimientos. Pero aquí estoy. Y estoy aquí gracias a mucha gente, con la que he aprendido mucho, y no sólo en clave académica sino como persona. Seguramente esta página no haga justicia a lo agradecido que estoy a las personas que comentaré a continuación. Pero lo intentaré.

Primero, gracias a Josep Blat por...todo. Con él descubrí el mundo de la IPO, con él me he formado como investigador, profesor, y como persona. Haciendo uso de uno de sus consejos (piensa lo que quieres decir y si puedes decirlo en 2 palabras, mejor), aquí va mi intento: GRACIAS MIL! Gracias a Josep también he tenido la oportunidad de trabajar con un grupo de investigadores y personas extraordinarias, el GTI. Bajo la excelente supervisión de Toni me comencé a interesar por la investigación. Davínia, Ernesto y Jesús han sido revisores de mi trabajo mientras lo iba haciendo y fuente de motivación (intentando ser como ellos). Tampoco me puedo olvidar de Dai, con el que mi inglés ha ido mejorando y por estar siempre dispuesto a revisar mis artículos. Con Fabien..que puedo decir del tipo que se fué al MIT, un placer trabajar con él. Y...el Sr. Ayman Mognieh. Muchas veces he querido dejar la tesis porque estaba harto, pero su inagotable energía se contagia.

A mi segunda familia en Ágora le debo dar las gracias primero por permitirme soñar, y segundo, por haberte permitido formarme como investigador y aprender mucho de la vida. Siempre me decís que vosotros aprendéis mucho de mí. Quizá no llegáis a imaginaros lo que yo he aprendido de vosotr@s. Y espero seguir haciéndolo.

A mis estudiantes de PFC también les tengo que agradecer su interés y ganas en trabajar conmigo y sobre mis cosas.

Finalmente, pero no menos importante, es agradecer a la gente que ha estado ahi y que me ha ayudado en estos años de duro trabajo. Además de mis padres, que ya es mucho decir, a Francis, Edu y Sergi siempre han estado cuando les he necesitado. Edu y Sergi con nuestras conversaciones de futbol; con Francis, que te voy a decir...daría para un libro. Tampoco me olvido de Victor y Fuanfo, compañeros de carrera y de más de una aventura.

Last but not least, I am indebted to Deirdre Henson for enhancing my English and being an excellent teacher. A tod@s, muchas gracias.

Abstract

Population ageing and the role of computers in current society have created a need to strengthen HCI with older people. The current paradigm considers them as a set of factors and central to it is compensation for age-related changes in functional abilities. This dissertation proposes a different paradigm: from factors towards interaction based on older people as social actors. Within this paradigm, compensating for diminishing abilities is not the cornerstone of research. Instead, interaction and real-life use should be closely intertwined. Against this framework, the thesis presents the results of an extensive ethnographic work on e-mail and web use. Quantitative and mixed methods are employed in other aspects related to use and interaction which complement this major study. Other chapters include methodological contributions to real-life evaluation. The dissertation discusses strategies for approaching HCI with older people. Central to them is the concept of life experience and the need to turn to everyday interactions by combining classical ethnography with experimentations.

Resumen

El envejecimiento de la población y la importancia de las TIC en la sociedad actual han motivado la necesidad de integrar más a las personas mayores en la interacción persona-ordenador. La investigación actual se centra en factores individuales del envejecimiento y la aproximación más generalizada es diseñar interfaces considerando a las personas mayores como un conjunto de factores. Esta tesis doctoral plantea un paradigma diferente: de factores a personas mayores como actores. En este paradigma, prestar atención a los cambios en capacidades funcionales no es lo único que importa, sino que interacción y uso real deberían estar más fuertemente relacionados. En este marco, esta tesis presenta los resultados de un trabajo etnográfico extenso sobre el correo electrónico y la web. Métodos cuantitativos y mixtos se han utilizado en otros aspectos, que apoyan este estudio de campo. Otros capítulos presentan contribuciones metodológicas en evaluación en entornos reales. La tesis acaba proponiendo estrategias para investigar con personas mayores como actores sociales, insistiendo en considerar la experiencia de vida de la gente mayor y estudiar más el uso y las interacciones en entornos reales combinando etnografía y trabajo más experimental.

Resum

L'envelliment de la població i la importància de les TIC a la societat actual han motivat la necessitat d'integrar més a les persones grans en la interacció persona-ordinador. La investigació actual es centra en factors individuals de l'envelliment i l'aproximació més generalitzada és dissenyar interfícies considerant les persones grans como a conjunt de factors. Aquesta tesi doctoral planteja un paradigma diferent: de factors a persones grans com a actors. En aquest paradigma, prestar atenció als canvis en capacitats funcionals no és l'únic que importa, cal que interacció i ús real estiguin més fortament relacionats. En aquest marc, aquesta tesi presenta els resultats d'un treball etnogràfic extens sobre el correu electrònic i la web. Mètodes quantitatius i mixtes s'han utilitzat en altres aspectes, que recolzen aquest estudi de camp. Altres capítols presenten contribucions metodològiques en avaluació en entorns reals. La tesi acaba proposant estratègies per a investigar amb persones grans com a actors socials, insistint en considerar l'experiència de vida de la gent gran i estudiar més l'ús i les interaccions en entorns reals combinant etnografia i treball més experimental.

Table of contents

5. ETHNOGRAPHY, USE AND INTERACTION

6. CONCLUSIONS

7. REFERENCES

ANNEX I. RESEARCH ACTIVITIES SURROUNDING THIS THESIS

List of figures

List of tables

1. INTRODUCTION

Population ageing and the importance of ICT (Information and Communication Technologies) in current society have created the need to greatly improve HCI (Human-Computer Interaction) with older people[1]. Central to current research is compensating for age-related changes in functional abilities (vision, cognition, hearing and mobility). Examples range from guidelines to hardware and software developments [13]. Some published papers contained in this thesis, which are presented later on, are in line with this approach and show that cognitive load is a key factor[2] for improving interactions in several areas (e.g. online forms, assistive technologies and mobile devices). However, and perhaps due to the fact that HCI with older people has its roots in Human Factors [4], far less consideration has been given to the fact that older people might be more than a set of factors. This dissertation proposes a paradigm that moves away from the conception of older people as factors; a paradigm which argues for considering them as social actors, which means grounding HCI in an understanding of use in social contexts.

This dissertation has explored HCI with older people from two (intertwined) perspectives, interaction and real-life use. The areas of interaction we have explored are: (i) applications such as online forms, ICT training, word-processing functionalities, strategies for seeking online information or e-mail systems); (ii) development processes: design methods, interaction measures and guidelines for web accessibility); (iii) input and output devices such as assistive technologies or web mobile formats. The areas of everyday use that we have analysed, and we discuss later, are: (i) interaction and accessibility barriers and the relative relevance of vision, cognition, mobility and hearing); (ii) e-mailing type and content of

---

[1] In this dissertation, older people are individuals over the age of 65 that experience normal age-related changes in functional abilities. However, these changes do not impact on their abilities to carry out daily life activities on their own.
[2] Each paper discusses the specific state-of-the-art of each area

communication, social circles, interactive experiences and relationship with ordinary technologies[3].

The research techniques employed have been quantitative, such as the test of hypotheses in experimental designs; qualitative, Grounded Theory for ethnographical data [2]; and mixed, combining quantitative (e.g. errors) and qualitative data (e.g. interviews) in usability tests.

After this very synthetic overview of the main contributions of this dissertation to HCI with older people, wherein is discussed the aspects of work explored and the techniques used, a summary of specific contributions to use and interaction is presented in Section 1.1 and 1.2, respectively.

1.1   Main contributions to use

The contributions summarised below are presented in papers [14] and [16] in Chapter 5. Both draw upon a 3-year ethnographical study of the everyday interactions of almost 400 older people with ICT. Observations, and formal and informal conversations were carried out weekly while they were using a broad range of technologies.

Individual interactions are turned into social ones, as the main motivation for older people to adopt ICT is to socialise. Not only does socialisation happen digitally, by means of online communication, but also physically and mediated by the digital one. A noteworthy example is e-mailing, which becomes an intimate and social activity carried out in the company of a close friends [16]. Whereas this social e-mailing differs from the private and individual one of other population ages, it is similar to the (shared) use of mobile phones amongst teenagers [8].

Software and hardware technologies that improve ICT accessibility but make older people feel or look different are rejected because their aspiration is to feel included [14]. They want to use the same technologies as those employed by key members of their social

---

[3] These areas cover the general HCI topics described by the SIGCHI Committee, http://sigchi.org/cdg/cdg2.html

circles (grandchildren and children). This need for being ordinary users challenges developments and assumptions within industry and academy [10], which obtain excellent experimental results focusing on "larger than average fonts" (pp: 356) but that are bound to face acceptance barriers outside the labs.

Older people do not mind how much time is spent on doing a task or that the number of tasks done in an hour might be small. What is truly important for them is not to rely on anyone else. Older people have been struggling to be independent individuals in their adulthood and want to be so with ICT in their old age [14]. Whereas this apparently inefficient and slow use is at odds with the productive model which a lot of systems have been designed for, it concurs with recent trends in HCI, moving away from work to non-work use of ICT [1].

ICT are enjoyed by older people when they use them. The feeling of accomplishment after having done a difficult task by themselves or been actively involved in an everyday conversation about computers with their children in which older people used to be bored listeners, and the thrill of still being important to people when receiving e-mails from them are some examples of the variety of interactive experiences [16] that go beyond technophobia, the only experience felt by older people according to current research [9].

1.2   Main contributions to interaction

The contributions summarised below are presented in papers ([15], [18]) in Chapter 2; ([17], [20], [19]) in Chapter 3 and [21] in Chapter 4.

Let us start by outlining some contributions related to methods and techniques. While the current mainstream HCI approach favours individual methods, the need for them to be turned into social ones framed in real-life research, due to the relevance of socialisation is shown. Even traditional usability tests are better conducted in pairs since individual interactions are unnatural practices for older people. This result is independent of previous experience with ICT

and context[4]. The number of errors is a more relevant usability evaluation means than time, as the use is not for productivity purposes, as stated earlier, and the goal is to be independent users. Filling out questionnaires is an activity with a potential effect on increasing isolation. However, interviews are easier to conduct and even a quite natural way of recruiting older people as test users, as interviews are seen as an opportunity of establishing social contact with researchers in a very natural way. Yet, current mainstream HCI research is based on methods taking places in artificial situations ("attending the university") and solely focused on functional abilities [5]; in the next paragraphs we turn to contributions related to the latter aspect.

Whereas assistive technologies and WCAG (Web Content Accessibility Guidelines)[5] are highly beneficial to the disabled [11], usability tests carried out while designing websites for different old-age pensioner associations revealed that screen magnifiers and onscreen keyboard and guidelines recommending alternative ways of online navigation based on the keyboard are of no use for older people. They increase exclusivity, which goes against the goal of being ordinary users.

Diminishing cognitive load is more significant than enlarging system elements for improving interactions since failing to remember steps and making mistakes hinder independence. In online forms, an experimental study with 48 participants revealed that making asterisks bigger or using other type of visual clues does not help older people to fill in web forms correctly[6]. Nevertheless, dividing required and optional fields into two separate sections reduces errors significantly. When adapting web sites to mobile formats (PDA), older people are perfectly able to interact with small-size content, whereas they have difficulties remembering

---

[4] In addition to the papers presented in the body of this dissertation, Annex I discusses a number of studies that have been carried out during the period of this thesis in several contexts, namely old-age pensioner associations and adult centres in Barcelona (Spain), some of which having been published as well.
[5] Promoted by the WAI (Web Accessibility Initiative) within the W3C, http://www.w3c.org/WAI
[6] The same result was obtained in a follow-up study. See Section 1 in Annex I.

steps while navigating[7]. These results contradict current assumptions in HCI research about the relative relevance and importance of interaction barriers, an issue that had not been addressed before [7].

Some of the contributions are related to the importance of realising that the life experiences with enabling technologies acquired during one's lifetime do impact on the way older people learn to and interact with ICT. In training, which has to take an "informal" orientation to motivation, individual activities and programs make little sense. Older people have learned most of the things they know by talking rather than reading and technologies supporting education need to foster communication. When e-mailing, they do not manage their attachments (only open them) because they do not have this habit with paper mail[8]. Methodologically, cognitive interview techniques revealed that Likert scales yield invalid results because they differ from everyday rating scales, whose elements are displayed vertically (and from better to worse) and not horizontally. Whereas this life experience concurs in some way with findings from senior education and life course in ageing [22], HCI does not currently consider ageing as a social process to be of the relevance it should be.

1.3   Further reflection on the contributions

Having reviewed the main contributions of this thesis and indicated how they were made, at this stage it might be worth reflecting briefly on where they are taking us in terms of pushing current research forward. In terms of use, the results portray older people as individuals that want to be ordinary, independent and social computer users. This conception of older users differs radically from the one considered within the current paradigm, based on factors. In terms of interaction, the most salient overall finding might be that 'compensating for' is not at all the only thing that matters in order to overcome interaction barriers. Older people's goals of inclusivity, independence and socialisation have a direct

---

[7] The relevance of cognition over vision was also found in the design of web sites for different old-age pensioner associations and the user interface of a YouTube for seniors. See Section 1 in Annex I

[8] This strategy also reduces cognitive load (e.g. where did I put that photo? It is in that (e) mail to or from someone, or of that period, which are memory clues)

impact on a lot of areas, such as how we carry out research with older people, the severity of interaction barriers, the acceptance of assistive technologies and the new concept of life experience in interaction. The contributions to use and interaction, and even most importantly, the strong relationship between them (interaction should not be understood in isolation out of the social context), give strong evidence in favour of the paradigm proposed in this dissertation.

1.4   Organisation of this dissertation

The body of this dissertation consists of 8 papers. Most of them having been published, one is being reviewed after initial acceptance and one has been accepted for publication. They are representative of the research undertaken in the thesis period. The result of 21 additional published papers, some already mentioned in footnotes of this introduction, are discussed in an annex.

The papers that form the body of this report have been divided thematically into four chapters. Each chapter is preceded by a one-page summary of results.

Chapter 2, *Methods and Interaction Measures*, presents [15] and [18]:

[15]. Sayago, S. and Blat, J., 2009.: Life experience and socialisation in some HCI methods with older people. Accepted for publication in *CHINZ'09,* July 6-7, 2009, Auckland, New Zealand. ACM 978-1-60558-574-1.

[18]. Sayago, S. and Blat, J., 2008. Exploring the role of time and errors in real-life usability for older people and ICT. in Miesenberger, K., Klaus, J., Zagler, W. and Karshmer, A. (Eds.), *Computers Helping People with Special Needs*. Lecture Notes in Computer Science, Springer, pp: 46-54

In the first one, the socialisation of significant HCI methods (usability tests, questionnaires and interviews) and the impact of life experience on them are addressed. In the second, the relevance of errors over time as a more suitable interaction measure than those

currently employed is discussed by drawing upon an ethnographical study.

Chapter 3, *Three Examples of Interaction Analysis*, presents [17], [19], [20]:

[17]. Sayago, S. and Blat, J., 2008. How relevant is selective attention in the design of online forms for older people? *Workshop on Cognition and the Web 2008: Information Processing, Comprehension and Learning*. Granada, Spain. April 24th-26th, pp:101-109

[19]. Sayago, S. and Blat, J., 2006. Adapting an online website to a Palm OS with young elderly people. *IADIS International conference WWW/Internet 2006*, Murcia (Spain). pp: 115-119, ISBN: 972-8924-19-4. Edited by: Pedro Isaías, Miguel Baptista Nunes and Inmaculada J. Martínez

[20]. Sayago, S., Camacho, L. and Blat, J., 2009. Evaluation of techniques defined in WCAG 2.0 with older people. *International Cross-disciplinary Conference on Web Accessibility* (W4A-ACM), pp: 79-82, April 20-21, Madrid (Spain). ACM ISBN: 978-1-605558-561-1

The first one presents a quantitative study of strategies for distinguishing required and optional fields in online forms. The second discusses the adaptation of a web site designed for an old-age pensioner association to a mobile format (PDA). The usefulness of the most important accessibility guidelines, WCAG; is discussed in two case studies in the third paper.

Chapter 4, *Social Aspects and Life Experience*, contains [21]:

[21]. Sayago, S., Santos, P., Arenas, M. and Gonzalez, M., 2008. Meeting some educational needs of elderly people in ICT: Two exploratory case studies. *ACM Crossroads*, 14.2

In this paper, two exploratory case studies in ICT-mediated training are presented. Both reveal the importance of life experience and

social circles in order to meet the educational needs of older people in ICT and enrich the educational experience.

Chapter 5, *Ethnography, Use and Interaction*, contains [14] and [16]:

14]. Sayago, S and Blat, J., 2009. About the relevance of accessibility barriers in the everyday interactions of older people with the web. *International Cross-disciplinary Conference on Web Accessibility* (W4A-ACM), pp: 104-113, April 20-21, Madrid (Spain). **Best Paper Award**. ACM ISBN: 978-1-605558-561-1

[16]. Sayago, S. and Blat, J., 2009. Telling the story of older people e-mailing. *International Journal of Human-Computer Studies*. Revision sent after first provisional acceptance.

In the first one, the relevance of interaction barriers such as those related to vision, cognition, hearing and mobility in daily interactions is revealed and discussed. The story of older people e-mailing is told in the second paper. This story encompasses use, social circles, ordinary technologies, interactive experiences and interaction.

Annex I discusses other research activities carried out during the PhD period. As indicated earlier, part of it analyses briefly the result of some published papers, which provide additional support to the one presented in the body of this report; the others explore different HCI areas with older people; some degree projects supervised and carried out in different settings corroborate the findings of this PhD. We indicate some evaluation activities on a range of media technologies both carried out and co-ordinated in RTD projects with non-older people, which have partially resulted in some papers in eLearning, novel user interfaces, and reports. Some papers on HCI Education have also been published.

2. METHODS AND INTERACTION MEASURES

This chapter is about the requirement of adaptation of HCI methods to the special needs of older people. This chapter also deals with measures to evaluate interactions in the wild. It is divided into Section 2.1 and 2.2, which contain respectively the following papers.

[15]. Sayago, S. and Blat, J., 2009.: Life experience and socialisation in some HCI methods with older people. Accepted for publication in *CHINZ'09,* July 6-7, 2009, Auckland, New Zealand. ACM 978-1-60558-574-1.

[18]. Sayago, S. and Blat, J., 2008. Exploring the role of time and errors in real-life usability for older people and ICT. in Miesenberger, K., Klaus, J., Zagler, W. and Karshmer, A. (Eds.), *Computers Helping People with Special Needs*. Lecture Notes in Computer Science, Springer, pp: 46-54

Section 2.1 discusses the impact on life experience and socialisation on conducting relevant HCI methods. The current mainstream adaptation of HCI methods results from age-related changes in functional abilities. However, this section shows that other aspects of ageing are also worthy of attention through an ethnographical study and partical complementary studies carried out in different naturally occurring settings. The main finding is that methods centred on the individual, such as questionnaires and traditional usability tests, need to be turned into social ones because of the relevance of socialisation in using ICT and the knowledge and experience gained during lifetime by older people.

Section 2.2 claims that time is nowhere near as significant as errors in order to evaluate real-life interactions. This is based on a 3-year ethnographical study with almost 400 older people already mentioned. This prioritization of interaction measures is justified by: (i) the goal of independence, as older people do not want to rely on anyone else; (ii) the extra (cognitive) efforts required to overcome mistakes and (iii) the absence of the need to hurry while

using computers. The (lack of) relevance of (time) errors is independent of previous experience with ICT and educational level. A survey of leading HCI journals and conference proceedings shows that very little research had been done on this area before.

2.1 Life experience and socialisation in some HCI methods with older people

HCI methods need to be adapted to older people due to agerelated changes in functional abilities. Far less consideration has been given to other factors of ageing, despite being an individual, social and environmental process of change. This paper draws on several studies carried out in real-life environments and discusses the impact of life experience and socialisation on conducting relevant HCI methods. Likert scales do not match older people's model of everyday rating scales and this leads to invalid answers. Individual methods such as usability testing and questionnaires make little sense due to the relevance of socialization. This paper suggests and describes vertical Likert scales, usability tests in pairs and questionnaires used as the script of interviews as a way of working with older people in a more natural and effective manner.

a) Introduction

Population is ageing at the same time that ICT (Information and Communication Technologies) play an important part in current society. Whilst many efforts have been made to design better interactions for older people, far less consideration has been given to HCI methods. Nevertheless, our review, presented later, reveals that methods have to be adapted to older people because of their age-related changes in functional abilities (i.e. vision, cognition, hearing and mobility). Adaptation in this view considers ageing as a one-dimensional process. However, ageing is an individual, social and environmental process of change [2]. This complexity, together with the relevance of methods, seems to call for further research.

This short paper presents and discusses the effect of life experience and socialization on carrying out relevant HCI methods with older people, questionnaires, usability testing and interviews. Likert scales yield invalid results for they do not correspond with older people's experiences with everyday rating scales. Filling out

questionnaires is an activity with a potential effect on increasing isolation. However, socialization is a key aspect for older people to use ICT, and thus being interviewed is preferred to filling in questionnaires because of the opportunity of establishing social contact with researchers. Socialisation also impacts on traditional usability tests. They need to be conducted in pairs and pay more attention to errors than time variables, since individual interactions are unnatural practices for older people, independently of their previous experience with ICT, who do not use them for productivity purposes. These adaptations are also an essential element for recruiting older people to participate in research activities and challenge typical experimental evaluations focused on individual users performing activities efficiently.

These results draw on a number of qualitative and quantitative studies carried out in real-life environments during a 3-year ethnographical study of the everyday interactions of nearly 400 older people with ICT [13].

Section b) reviews studies of HCI methods with older people and situates them into the broader context of HCI and ageing. This section also outlines our ethnographical approach. Next we show the effect of life experience and socialization on questionnaires, interviews and usability testing and how we carried out them. Section e) discusses the results. Section f) presents the main conclusions and outlines future research perspectives.

b) Related work and approach

Experimental design and methodologies such as cognitive testing, self-reporting, thinking-aloud and user diaries ought to be modified in order to attract, retain and work with older people due to low literacy, a lack of previous experience with ICT, sensory and cognitive changes, and limited mobility [4]. Compensating for age-related changes in functional and communicative abilities is of great importance in order to run effective focus groups [1]. The lack of confidence felt by older people in ICT is also a requirement of adaptation, which seems to be met by presenting focus groups as social events [6]. Age-related changes in working memory affect the design of questions and responses in questionnaires and structured interviews [15]. While the order of questions (specific

preceding general) does not affect older people's judgments as opposed to younger individuals, response order effects increase considerably with age.

Common to these studies is compensation for age-related changes in major life functions, which concurs with mainstream HCI research with older people. Examples range from web accessibility [12] and user interface design [9] to design of training programs and devices [7]. Nevertheless, research on other areas with a connection with HCI, such as senior education and health care, in addition to the psychology of ageing and life course research [16], has shown that ageing is a much more complex process. Older people bring with them experiences and knowledge that younger people do not have. This life experiences have a relevant impact on education [8] work and leisure activities [16]. Social relationships are also very important in determining the well being of an individual in later life [11].

Motivated by the growing awareness to understand how people interact and make use of technologies in their daily lives in order to design better interactions [3], we carried out an ethnographical study aimed at grasping the everyday interactions of older people with ICT. Let us now outline some aspects of this study that will help the reader contextualize the results presented next.

We worked with 388 older people with low educational levels (300 with primary school) and a general lack of experience with ICT (only 38 did have contact with ICT in their jobs). All of them had a strong motivation to use the new technologies in their daily lives in order not to lag behind in current society and reduce isolation. In addition to observing and conversing with them while using many technologies on a daily basis, ranging from e-mail systems and web browsers to MS Office tools, we also carried out quantitative studies in a number of areas, word-processing functionalities, online searching strategies, e-mail functionalities and online forms. These studies were done in distinct environments, mainly old-age pensioner associations and adult centers in Barcelona (Spain)[9].

---

[9] We have created a web page with references to the studies related to our fieldwork that are cited in this paper:
http://www.tecn.upf.es/~ssayag/PhD/HCImethods.

Within this real-life context, life experience and socialization turned out to determine in large part the way in which relevant HCI methods should be carried out with older people. Section c) shows the impact of life experience on Likert scales, which are frequently used in questionnaires. Section d) shows the impact of socialization on questionnaires and usability testing.

c) Vertical Likert scales

Contrary to everyday rating scales (e.g.; the ten richest people in the world) where items are placed in vertical order, Likert scales display them horizontally. Nevertheless, older people draw firmly on their life experiences with traditional scales and the lack of connection between them and Likert scales leads to invalid responses.

In the design of a questionnaire for measuring the ease of use of word-processing functionalities, cognitive interviews [10] carried out with a group of 5 older people (2 women; 3 men) and 2 middle-aged people (1 woman; 1 man) revealed that older people did not understand Likert scales. They selected '1' and '5' independently of the adjective in the scale. As one user stated: *[Woman, 80]: "I don't know why you put the numbers in this way. The best thing, or the most expensive, goes always at the top, and the worst at the bottom"*. These interviews also revealed that valid responses were gathered when Likert scales were displayed vertically, as shown in Table 1. Moreover, changing numbers for words made scales easier to understand since *"difficult always means difficult, whereas 1 or 2 can have very different meanings" [Man, 70]*. Adult users did not have problems with either standard or vertical scales.

Standard Likert scale	Likert scale for older people	
Easy 1 2 3 4 5 Difficult	Very easy	1 Very easy
	Easy	2
	Normal	3
	Difficult	4
	Very difficult	5 Very difficult

Table 1: Standard and horizontal Likert scales

In evaluating strategies for online searching, another group of 18 older individuals (65-80; 10 men; 8 women) was asked to write down the five most difficult aspects involved in searching online

information. They did this at the end of a session in a computing course. Their "scales" were not horizontal but vertical, as depicted in Figure 1.

Difícil

ir a la carpeta-P21
Descargar imagen al PowerPoint
Poner el nombre por defecto a la imagen

Fácil

Buscar por Google
Tener la imagen en pantalla
Abrir una carpeta
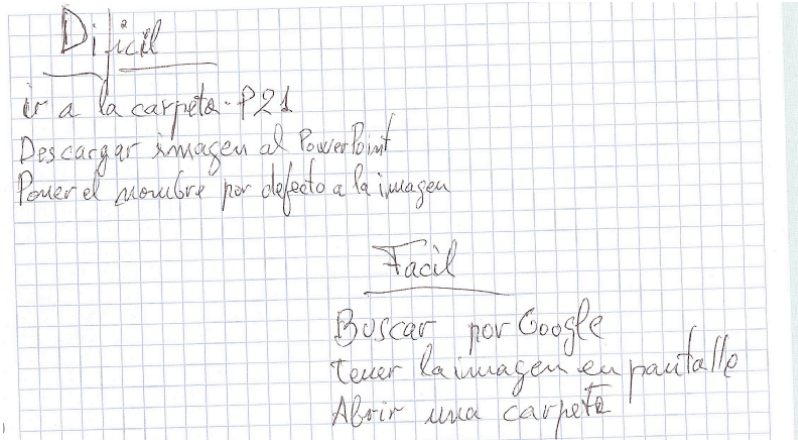
Figure 1: Example of vertical likert scales using groups

Figure 1 shows 6 tasks related to searching for a picture of a town in Google and downloading it to a folder. These tasks are rated by their level of difficulty. The most difficult and easiest tasks are placed at the top of the rating scales. They are also classified into two groups, difficult (left) and easy (right). According to these Likert scales, the most difficult task is to open a folder in a shared network and the easiest one is to interact with Google.

When they were asked in a focus group session about their scales and the ones used in standard HCI questionnaires such as QUIS, they voiced that the latter were very misleading, which concurs with our previous study of word-processing functionalities.

[Man, 67]: "These horizontal scales are nonsense for us. In the real world, we are used to seeing vertical scales. Have you had a look at newspapers? The best football team goes at the top. The most expensive car goes at the top of scales. I have never seen the classification of these things horizontally in newspapers or on TV"

d) Socialisation of methods

Individual usability tests focused on performance need to be adapted. At initial stages of learning, older people interact with ICT

with close friends. This type of social interaction makes them feel more confident as they fear of making mistakes, which is much more important than being efficient while mastering ICT. Moreover, interacting in pairs is considered as the most natural way for them to learn. In designing ICT-mediated training we found that older people do not have the habit of reading manuals to master technologies (either digital or ordinary ones such as washing machines), which differs from other age groups such as their children and grandchildren.

[Researcher]: If you do not remember how to do something, you might consider having a look at the online help

[Woman, 75]: Don't take what I'm going to tell you amiss, but I prefer to ask you.

[Researcher]: Well, young people also prefer to ask, but…

[Woman, 75]: I'm not so sure about that. For instance, my grandchildren, aged 15, and my children do read manuals when they do not know how to deal with a machine, like TV or PCs.They are used to doing that. Also, they have to read and get by on themselves in their jobs. However, I do not have the habit of reading for finding solutions. Have you ever seen an old folk like me reading a manual for setting up the washing machine? I'm sure they will talk the guy who brings it to their home to explain to them how the machine works! All the things that I and we know are thanks to talking to people, as we did not study!

Older people with more experience with ICT also interact in pairs. They do this because their main reason for taking up computers is to socialize. They do not want ICT to isolate them further. For instance, they turn some individual and private activities into social and intimate ones, such as e-mailing. Also, older people use ICT in their free time and do not want to use them for productivity purposes [14]. Hence, spending more or less time on carrying out an activity is nowhere near as important as going wrong, which hinders their daily interactions [13].

Thus, traditional usability tests within the task-performance model are very unnatural and unrealistic practices. Instead, pairbased

usability tests measuring the number of errors are easier to conduct. Also, they evaluate key interaction aspects. We carried out this type of usability testing in several experiences, such as designing three websites for different old-age pensioner associations and the user interface of a You tube for seniors. The main differences with respect to the standard one are that individual thinking-aloud protocols are turned into discussions, which reflect the discovery of interactions in a much richer way than having a single user talking alone, and typical post-test interviews are carried out in pairs.

It is worth mentioning that the significance of social support in adapting usability tests to older people has been identified before [4, 5]. However, what has not been previously highlighted is the relevance and impact of previous learning strategies and socialization on the requirement of adaptation.

Not only is socialization relevant in usability tests, but also in questionnaires. Difficulties filling in them due to age-related changes in cognition were less apparent in our studies than those related to the need to turn them into a social activity[10]. Older people are reluctant to fill out questionnaires as they see in doing so an activity that limits their socialisation. Questionnaires are easier to conduct when they are used as interviews' scripts, which allow older people to establish a conversation (social contact) with researchers in a very natural way, in addition to making them more willing to participate in research activities, as the following extract shows. These conversations are similar to structured interviews. However, two relevant differences are (i) older people tend to give more information (e.g. reminiscence) and (ii) the researcher might consider making the most of it (e.g. dealing with unexpected but relevant comments, such as in a conversation), as the information gathered is much richer than the data which would be gathered in

---

[10] We did not gather enough evidence in order to argue that difficulties in written language comprehension and generation are relevant factors in conducting questionnaires with older people. For instance, they write long and short e-mails on a daily basis. Some of these e-mails involve answering questions and expressing their opinions in the natural course of communicating with their children, grandchildren and close friends. Older people also take notes in computer courses by using paper and pencil, which suggests that difficulties in writing due to changes in manual dexterity might not be a barrier for them to answer open-ended questions.

the "standalone" questionnaire. The socialisatio of questionnaires illustrated in Figure 2.
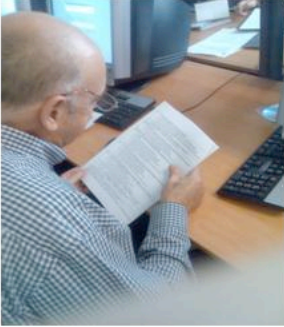
[Researcher]: Here you have a questionnaire for you to fill in.
[Man, 65]: I don't know why you ask us to fill in questionnaires. It is much easier for us to talk to you.
[Researcher]: Do you have problems writing or reading? I have seen you taking notes in the course...
[Man, 65]: I don't have problems! Writing is tiring...but the most important thing is that we want to talk to people.
[Researcher]: What do you mean?
[Man, 65]: Well, I can fill in a questionnaire. Maybe I will have some difficulties answering questions. However, I do not want to fill out a questionnaire as I will be alone in so doing. I want to talk to you and spend some time with you and other people. For instance, last week you interviewed us in pairs, do you remember? This was very natural and we enjoyed.

Figure 2: Scenario about socialising questionnaires

e) Discussion

We have explored the requirement of adaptation of important HCI methods in a number of studies. Previous research approache this issue by considering "older people attending the university" [4]. Within this perspective, age-related changes in functional abilities emerged as the most important factors to be considered in conducting methods with them. Nevertheless, we thought that widening the focus from "university" to "researchers attending old-age pensioner associations and adult centers" was worthwhile, especially because older people do not use ICT at universities in their daily lives.

The results presented show that there is a fundamental need to adapt methods, which concurs with previous research. However, the requirement of adaptation is not only due to age-related changes in

major life functions. We have identified, described and discussed the relevance of life experience and socialization. Even though these aspects are not really new, as we have indicated before, what is new is the need to consider them in carrying out questionnaires, usability tests and interviews.

We do not claim that the results are representative of different cultural contexts. Nevertheless, our participants are both learning and using ICT in their daily lives. These two characteristics make them a very important (and growing) sector: run-of-the-mill people aged 65+ using the new technologies.

f) Conclusions and next steps

Conducting HCI methods with older people is not simply a matter of compensating for age-related changes in vision, hearing, cognition and mobility. Life experiences and socialization are worthy of attention as well. Likert scales should be displayed vertically; individual methods are artificial; interviews are preferred to questionnaires and time is less important than errors. These findings challenge current research focused on experimental methods and evaluations under laboratory conditions, and also reinforce the idea of exploring interactions in real-life settings, which warrant much more research.

In light of the importance of life experience, we are re-examining all our ethnographical data and planning more qualitative and quantitative studies with the aim of gaining a deeper insight into the role of this factor and the way in which it can be formulated to enhance HCI methods. Motivated by the relevance of socialisation we also intend to deepen our research and explore the challenges and opportunities in turning individual methods into social ones and the evaluation parameters that best capture the interactions. We are also considering exploring computermediated methods, which might be an option to develop more comprehensive research with older people, with or without difficulties in mobility.

g) Acknowledgements

We thank all our participants for deepening our understanding of

HCI and allowing us to share their views with the rest of the world. We also thank Fabien Girardin for his comments and ideas which helped us to improve our work.

h) References

[1] Barrett, J. and Kirk, S., 2000. Running focus groups with elderly and disabled elderly participants. Applied Ergonomics, 31. 621-629

[2] Birren, J.E. and Schroots, J.J.F., 2001. The History of Geropsychology, in: Birren, J.E. and Schaie, K.W. (Eds.), Handbook of the Psychology of Aging, Academic Press, San Diego (California), pp: 1-26.

[3] Blomberg, J., Burrell, M. and Guest, G., 2003. An ethnographic Approach to Design, in: Jacko, J.A. and Sears, A. (Eds.), The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, Lawrence Erlbaum Associates, London, pp: 964-987.

[4] Dickinson, A., Arnott, J.L. and Prior, S., 2007. Methods for human-computer interaction research with older people. Behaviour & Information Technology, 26 (4), 343-352

[5] Dickinson, A., Smith, M.J., Arnott, J.L., Newell, A.F. and Hill, R.L., 2007. Approaches to Web Search and Navigation for Older Computer Novices, in CHI 2007, (San Jose, California), 281-290

[6] Eisma, R., Dickinson, A., Goodman, J., Syme, A., Tiwari, L. and Newell, A.F., 2004. Early user involvement in the development of information technology-related products for older people. Universal Access in the Information Society, 3. 131-140.

[7] Fisk, A.D., Rogers, W.A., Charness, N., Czaja, S.J. and Sharit, J., 2004. Designing for older adults. Principles and Creative Human Factors Approaches. CRC Press

[8] Glendenning, F, 2004. Education for Older Adults: Lifelong Learning, Empowerment, and Social Change, in Nussbaum, J.F. and Coupland, J., (Eds). Handbook of Communication and Aging

Research, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp: 523-543.

[9] Hawthorn, D., 2000. Possible implications of aging for interface designers. Interacting with Computers, 12, 507– 528.

[10] Jobe, J.B., Keller, D. M., Smith, A. F., 2000. Cognitive Techniques in Interviewing Older People, in: Schwarz, N. and Sudman, S. (Eds), Answering Questions. Methodology for Determining Cognitive and Communicative Processes in Survey Research, Jossey-Bass Publishers, San Francisco, pp: 197-221.

[11] Krause, N., 2006. Social Relationships in Late Life, in: Binstock, R. and George, L.K. (Eds.), Handbook of Aging and the Social Sciences, Academic Press, pp: 182-198.

[12] Kurniawan, S.H., 2008. Ageing, in: Harper, S. and Yesilada, Y. (Eds.), Web Accessibility. A Foundation for Research, Springer, pp: 47-61.

[13] Sayago, S. and Blat, J., 2009. About the relevance of accessibility barriers in the everyday interactions of older people with the web, in International Cross-Disciplinary Conference on Web Accessibility (W4A), (Madrid, Spain), April 20-21 pp: 104-113, Best Paper Award. ACM ISBN: 978-1-605558-561-1.

[14] Sayago, S. and Blat, J., 2009. Telling the story of older people e-mailing: an ethnographical study, submitted to the International Journal of Human-Computer Studies.

[15] Schwarz, N. and Knäuper, B., 2000. Cognition, aging, and self-reports, in Park, D. and Schwarz, N. (Eds). Cognitive Aging: A Primer, Taylor & Francis, 2000, 233-253.

[16] Settersen, R.A. (Ed), 2003. Invitation to the Life Course. Toward new Understandings of Later Life. Baywood Publishing Company, New York

2.2 Exploring the Role of Time and Errors in Real-Life Usability for Older People and ICT

We explore herein the role of time and errors as usability measures in real-life usability for older people and ICT, drawing on observation and conversational data collected over a 3-year ethnographic study of the usability and accessibility of ICT for older people. The results show that time has little or no practical value in real-life usability, except for expected complains about slower PCs and Internet connections, unlike making the least number of errors. This finding is independent of educational levels and previous experience with ICT, and grounded in three factors: (i) desire of independency, (ii) extra efforts to overcome mistakes; (iii) using computers as a hobby.

a) Introduction

The purpose of this paper is to explore the role of time and errors as usability measures in real-life usability for older people and ICT. The work presented herein is part of a 3-year ethnographic study of the accessibility and usability of ICT with/for older people.

Our focus on ethnography and real-life usability, concentrating in this paper on time and errors, has three motivations. First, based on our previous research on ICT accessibility with elderly adults[11], we thought that getting an insight into the interactions of older people with ICT as they occur in everyday settings was a needed major step forward to design better ICT for ageing. Understanding the everyday realities of people has proven to be an essential element in designing better technologies [1], so we elected to do that with older people and ICT, adopting an ethnographical approach. We carried it out in an adult school, where older people both take a broad array of digital literacy courses and use computer and online technologies on a daily basis. See Section b) for further information.

Second, there is a growing realization that measuring usability in real-life situations is crucial to designing better technologies [7].

---

[11] We have explored several areas, ranging from design methods, mobile web accessibility, online forms, online searching to guidelines.
http://www.tecn.upf.edu/~ssayag

Nevertheless, rather than understanding usability as it actually is in everyday settings, where older people are much more likely to use ICT than in office or productivity environments, much research on usability and older adults is focused on adapting design and usability methods to them (e.g. [2]). Illustrating briefly this fact, our survey[12] of four leading HCI journals (Interacting with Computers, first issue-2008; International Journal of Human-Computer Studies, first issue- 2008; Universal Access to the Information Society, first issue-2008; ACM Transactions of Human-Computer Interaction, first issue-2008) and CHI ACM Proceedings, shows that no studies have been published to date reporting on real-life usability of ICT for older people.

Third, the question of which measure/s of usability to select is central to the design and development of user interfaces, and this decision is often challenged by the context of use [3]. There are reasons to think that classical usability measures, such as time and errors data of user performance [5], in addition to usability methods like user testing [7], might be meaningless in everyday settings, as the uses of computers are reaching far beyond office productivity environments [4]. Nevertheless, very little is known about the practical value of time and error as usability measures in real-life usability for older people and ICT. In this paper we aim to shed some light on that.

We intend to understand which of these two classical usability measures, time and errors, makes more sense (if any) for older people to use a wide range of ICT in everyday settings and why. Section b) gives an overview of our ethnographical study, outlining the context, implementation and qualitative analysis. Section c) presents the results of our analysis. Section d) shows the main conclusions drawn from our study, limitations and ongoing work.

b) Ethnographical Study: Context, Implementation and Analysis

Àgora is an association that teaches elderly people the skills needed to master new information technology. The association resides in

---

[12] Using a combination of several keywords: {"ethnography"; "fieldwork"} − { "older / elderly people / adults"} − {"real-life usability", "domestic usability"}

Barcelona, Spain. Àgora is mainly aimed at older people, hailing from different regions of Spain and countries, living in Barcelona and surrounding areas. Àgora offers a large number of services, courses in computing (e.g.; MS Word, MS PowerPoint and Internet) for inexpert and expert older people, free access to computer and online technologies daily, monthly meetings and workshops on ICT, just to mention some of them.

This paper is based on ethnographical data collected from 2005 to 2008 in Àgora, consisting of 5 in-depth interviews with middle-aged teachers, 20 interviews with elderly adults, and 260 direct observations and conversations[13] with older people using a wide range of ICT in courses, workshops, and for their own purposes. Older people have been observed frequently (2 to 3 times per week). Part of our ethnographical work has taken place in courses and workshops coordinated by the authors of this paper. Another important part of our fieldwork has happened in courses, meetings and workshops where we have attended as collaborators and participants. Table 2 aims to give an overview of our ethnographic implementation.

2005	Overview
Course: Gardens[14]*	Older people download pictures from the Web about National Gardens and design reports using MS Office tools and Web Pages. 18 older people during 6 months
Course: Towns in the World*	Older people download pictures from the Web about Towns in the World and design reports using MS Office tools and Web Pages. 18 older people during 6 months
Course: Internet	Older people use the email and strategies to look for online information. Courses lasted 1 month. 2 courses organized. 36 older people.
Monthly meetings	Participation in meetings to discuss the positive and negative aspects of the courses organized in the association. 40 older people.
2006	Overview
Online communication	Older people learn basic and advanced aspects of online communication (email, chats, blogs and forum) and strategies to look for online information. Courses lasted 3 months. 4 courses organized. 76 older people.
Workshops	Special sessions of 2-hour length each were organized about email, multimedia content edition and finding online information. 18 older people.

---

[13] This is a mistake in the original publication. It should read "observations and conversations with 260 older people".

[14] * We attended as collaborators and observers.

Monthly meetings	Participation in meetings to discuss the positive and negative aspects of the courses organized in the association. 30 older people.
2007	Overview
Advanced topics	Advanced topics of computer management, documents editing, online communication and searching, multimedia. Courses lasted 3 months. 4 courses organized. 76 older people
Resources online	Advanced topics of computer management, creation of documents online and online searching. This course lasts 6 months – nowadays. 18 older people.
Workshops	Online technologies to support educational practices of older people in ICT. 10 older people. Talking about social factors and ICT with older people. 24 older people.
Monthly meetings	Participation in meetings to discuss the positive and negative aspects of the courses organized in the association. 40 older people.

Table 2: Overview of the ethnographical implementation

In order to explore the practical value of time and error data in real-life usability for older people and ICT, we have asked them about that in-situ (i.e. using computers), as well as taking advantage of informal conversations, which usually happened before and after courses, meetings and workshops, and where references to time and errors were made in the normal course of natural dialogues. Follow-up interviews were also conducted to better understand our ethnographic notes. These interviews were semistructured, so that we could gather specific information on the topic without limiting the participants' contributions, and were carried out in the association' bar, where the participants felt at home.

The analysis of all this ethnographical data has been inspired by the procedure followed in Selwyn's study [6], in which a large number of qualitative data on the use of ICT by older people was analyzed. We have used the constant comparison technique (reviewed in [6]) in order to analyze all our observational notes and interview transcripts. This initially involved one analyst (Sergio) reading all the observational notes and interview transcripts to gain an overall sense of the data. All the data was then read again and open-coded to produce an initial code list until, in the opinion of the two authors of this paper, analysis had reached theoretical saturation. Much as some codes were adapted from the language of the participants, the majority were researchers-led and analytic, building upon our ongoing literature review of HCI and older people. From this basis,

the data was then selectively coded in terms of the categories identified with the initial list of codes directly tied to the aims and focus of this study (time and error).

Analysis elicited three factors underlying study participants' overwhelming preference for making the least number of errors. These can be grouped into aspects of independency, extra efforts to overcome mistakes, and uses of ICT as a hobby, which are explained in the rest of this paper.

c) Findings

We have divided the results into four categories: (i) low educational levels and little experience with computers, (ii) high educational levels and some experience with computers, (iii) context of use and (iv) uses of computers. We have found that education and experience with computers go often together, as those older adults with high (low) educational levels tend (not) to have previous experience with computers. Since all the informal and formal conversations were in Spanish, those cited in this article have been translated into English by the authors.

c.1) Little Experience with Computers and Low Educational Levels

It was noticeable that all older people with low educational levels and a general lack of experience with computers (200 of 260) turned out to have a stronger preference towards making the least number of errors rather than being efficient when using computers. As this man, who has spent all his life working in a farm, explains:

*"My experience after having worked in a farm during 60 years, and bringing up my children, is that we must not go wrong. If you make mistakes, you look useless or inappropriate for a given task. Moreover, you must make an extra effort to solve them, and you might need to bother other people to help you, and this is not good". **Well, what can you tell me about doing activities quickly?** To be honest, it is true that you can show off… if you are efficient. However, doing things quickly is not the most important thing in your life, I mean, it is much more important to do them correctly…because my life has taught me this lesson". [Male, 74]*

Other study participants expanded on the view of "looking useless", especially in terms of social embarrassment. As one retired women argued in a monthly meeting:

It is important that all of you start filling in the online form…"Sorry, let me break you in, but I would like to tell you that I find it rather difficult that some older people fill in this online form on their own…Why? Well, because some participants are ashamed to let you know that they make mistakes when writing … what will they do, then? The chances are that they will drop in and ask us to fill in the online form" [Female, 65].

Social embarrassment is worthy of attention, especially if we consider that most older people need to go to centers, such as adult schools, to learn to use computers, and it is also likely that they will continue using them in these centers, because of socialization and support.

Other participants stressed the relevance of independency and the consequences that making errors had on their pursuit of becoming independent computer users. As this woman explains:

"It is very frustrating to see that you can not do things with this machine on your own. Don't despair! I know, but the point is that I have been able to bring up my three children, working at the same time, and taking care of my mother and husband. And I have not required support from anybody. However, I can not move forward in this screen unless you help me" [Female, 70]

When the study participants were asked about doing computer activities faster, it was noticeable that none of them were interested in that.

Come on! The faster you go, the more training you receive! "Slow down! We, and I speak on behalf of all of us, do not need to rush; indeed, we do not want to use computers in a hurry, not like you! We want to take our time, because we have been rushing during all our lives; before, in our jobs; and now, with our grandchildren. We want to relax and use computers slowly" [Male, 74]

But, come one, you could try to be a little bit more "efficient"!
"The faster I go, the more mistakes I make. And, the most important thing is as follows. If using computers is a hard task for seniors, you can not imagine how difficult it is to overcome your own mistakes, when you have no clue about how to solve them!" [Male, 65]

It can be thought that this lack of interest in being efficient users is brought about by a lack of experience of the study participants with computers, and the fact that they were learning to use them. Nevertheless, this lack of interest seems to be independent of education and previous experience, and the context of use, as stated later on.

c.2) Higher Educational Levels and Previous Experience with Computers

We have not found the feeling of being useless amid older people with higher educational levels (secondary school) and previous experience with computers (60 of 260). A likely interpretation of this fact is provided by this teacher:

I have seen that older people are afraid of making mistakes…*"Yes, but not all of them. As you will see in the courses, those with previous experience with computers, old computers you know, are not afraid of going wrong" [Teacher, Female, 26]*

Nevertheless, we have realized that making mistakes is a major stumping block to becoming independent users, which is a recurring aspiration amongst older adults with and without previous experience with computer technologies.

Why do not you want to use computers faster? *"I am very happy not to have to write letters with MS Word in a hurry. I worked as a secretary, and we dashed around all day long. Now, I can enjoy using more aspects of MS Word, those you have taught us, in a mellow atmosphere. Also, in my work, when I tried to go faster, I made more mistakes, so I had to spend more time at work, which was an extra effort. Now, I am tired and I do not want to make such efforts (smiles). Easy does it, my friend" [Female,68]*

*Now you can take advantage of what you have learned in the course to try to select one strategy that helps you to copy-and-paste files quicker…"It's great to widen the number of alternatives, and I reckon that that using the mouse is quicker than my strategy, using the Edit menu. However, I tried to use it at home yesterday, with negative results. I ended up losing my photos… it was chaos! As you can understand, I will carry on using the Edit menu. **I hope you find them, but, if you get used to, you** … Yes, I did find my photos, they were… in a folder I did not click on, but…anyway, I have no interest in doing things quicker; I am mad about not being dependent on anyone. I do not want to bother either you, at school, or my children at home, who do not help me at all, and making mistakes is really annoying" [Male, 72]*

Thus, it seems as though using computers efficiently is much less important than making the least number of mistakes, and this is grounded in several aspects of their life experience, such as being hard-pressed at work and the consequences of making mistakes, a reluctance to bother other people, and a strong desire to be independent.

c.3) Context of Use

Throughout our observations and conversations, we have found that not only is making few mistakes important when using computers in the association, but also in the study participants' place of living.

*How is your homepage going? "Yesterday, I was trying to design a link in my homepage. I tried to apply what you told us in the course, but I could not. And I spent all day long, and my PC is getting slower and slower. **What happened?** The screen told me that the file did not exist, but the file was there, just in front me. It was very frustrating, because I realized that…although I do know how to do some activities, I am still dependent on people like you…And, on top of that, it was a pity, because my grandchildren, who came home yesterday, did not see my homepage, but I would have liked to show it to them, to show off!" [Male, 79]*

Did you practice yesterday with your new PC? "Yes! I have started scanning the articles that I have written during my entire career. I have worked as a sports journalist, and I know that my writings

*take up too much space at home, and when I die, they will disappear, but I do want my grandchildren to have a DVD of my writings. However, I do not know whether I am scanning my writings correctly, I will ask you latter, at the end of the session, as I think that I'm doing something wrong, and it is important for me to give this DVD to my grandchildren and being unable to do it on my own is disappointing…***No problem!** *And you asked me yesterday about using efficient strategies… (exclamation)! I prefer not to make mistakes… and want my Internet connection to be faster… this is important as I pay for that!" [Male, 64]*

Both extracts show that making errors is associated with a lack of independency and frustration, and the consequences are very negative, especially in light of the "personal" use of computers. References to time are complaints about slower Internet connection and processing capabilities of PCs.

c.4) Uses of Computers

We have found out that older people use computers as a hobby, not for productivity purposes, and this fact has a very strong impact on their preference towards making the least number of errors, which spoils more their hobby activities than slower PCs or Internet connections do.

"I have a problem. I am editing videos at home with [name of the software]. I have videos of several family events such as weddings and Christmas, and I am digitalizing them…I like videos. However, I get the impression that I am doing something wrong, because the message 'Load error from stream" appears every time I try to copy…What does it mean? ***Well, tomorrow we will have a look at it in the course. By the way, you always asked me about mistakes; never about doing things quicker, and in the courses…*** *I know, but the point is that I do not really care about shortcuts and all this jazz; I am mad about doing things correctly, because at home I do not have your support (smile). But time is also important, although much less than going wrong, I have an old computer, I will buy a modern one soon…! [Male, 69]*

What do you think about the email? *"It's great! I love it…***But you have spent more than 30 minutes to write an email, come on!*** Yes,*

*I know, is that I wanted to be sure that everything was OK. You know, using computers, you make something wrong, and it does not work; I must pay attention to details, and check and check. **Well, but you know how to surf on the Internet… and the more you spend, the more expensive it is!** Well, you should not think that people like me are experts; we know something…and about money, I think you are wrong. Because at home I have 24-hour Internet connection, a bit slow, but I can get by on that, and I do not pay more if I spend 2 or 3 hours online, so I don't care! [Female, 70]*

d) Discussion and Conclusions

The results of our study point out that time has little or no practical value in real-life usability for older people and ICT, except for somewhat expected complains about slower PCs and Internet connections, unlike making the least number of errors. Our analysis shows that the relevance of not going wrong is independent of educational levels, previous experience with computers, and contexts of use, and is grounded in three aspects related to real-life use of ICT by the elderly: (i) independency, (ii) extra efforts; (iii) and uses of computers for not productivity purposes.

Older people aspire to become independent computer users, and making mistakes is a major stumbling block to reaching it, rather than being efficient, as well as increasing the efforts they must made to use ICT. The desire of independency is well-documented in literature; and our study concurs with it, pointing out that independency is also important in real-life usability. The consequences of making mistakes are important in several contexts, and especially exacerbated in two contexts where older people are very likely to use ICT, home and social environments. At home, older people (i) try to use computers on their own but can get frustrated because they do not know how to overcome their errors, (ii) might loose personal information as a result of that, and (iii) can fail to show their relatives that they are able to use computers. In social environments, such as meetings and courses, older people can try to avoid participating in computer activities which reveal heir weaknesses, and they might end up being excluded or lagging behind. All these aspects might deter older adults from using ICT, which is worthy of attention. We have also found that older adults do not use ICT as productivity tools, but as a hobby, which concurs

with [6]. The variable time seems to be much less relevant in hobby activities than making mistakes, which spoils computer activities in their free-time.

These findings are of course conditioned on the limitations of this study. We have done fieldwork in a specific context, with Spanish older people and ICT. Only one of the authors coded the ethnographic data. The results might be challenged for their veracity and extrapolation to other contexts, as in any type of ethnographic study.

Despite these limitations, we hope that our study has contributed to enhance the knowledge and understanding of real-life usability for older people and ICT. This topic area is largely unexplored, and warrants much more research. We are currently analyzing our ethnographic data in order to understand more aspects of real-life usability for older people, such as real-life interactions and use (e.g. gender differences, individual or group usage), contextual measures of usability (parameters to measure"easy" or "difficult" in real-life interactions), and use and evaluate them in concrete case studies. We thank Agora and our study participants for their support.

e) References

[1]. Blomberg, J., Burrell, M., Guest, G.: An ethnographic Approach to Design. In: Jacko, J.A., Sears, A. (eds.) The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, pp. 964–987. Lawrence Erlbaum Associates,London (2003)

[2]. Eisma, R., Dickinson, A., Goodman, J., Syme, A., Tiwari, L., Newell, A.F.: Early user involvement in the development of information technology-related products for older people. Universal Access in the Information Society 3, 131–140 (2004)

[3]. Hornbaek, K.: Current practice in measuring usability: Challenges to usability studies and research. International Journal of Human-Computer Studies 64, 79–102 (2006)

[4]. Karat, J.: Beyond Task Completion: Evaluation of Affective Components of Use. In: Jacko, J.A., Sears, A. (eds.) The Human-

Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, pp. 1152–1163. Lawrence Erlbaum Associates, London (2003)

[5] Nielsen, J.: Usability Engineering. Academic Press, Boston (1993)

[6]. Selwyn, N.: The information aged: A qualitative study of older adults' use of information and communications technology. Journal of Aging Studies 18, 369–384 (2004)

[7. Thomas, P., Macredie, R.D.: Introduction to The New Usability. ACM Transactions on Computer-Human Interaction 9(2), 69–73 (2002)

3. THREE EXAMPLES OF INTERACTION ANALYSIS

This chapter is about interactions within the context of specific applications, guidelines and devices. The section 3.1, 3.2 and 3.3, contain respectively the following papers.

[17]. Sayago, S. and Blat, J., 2008. How relevant is selective attention in the design of online forms for older people? Workshop on Cognition and the Web 2008: Information Processing, Comprehension and Learning. Granada, Spain. April 24th-26th, pp:101-109

[19]. Sayago, S. and Blat, J., 2006. Adapting an online website to a Palm OS with young elderly people. IADIS International conference WWW/Internet 2006, Murcia (Spain). pp: 115-119, ISBN: 972-8924-19-4. Edited by: Pedro Isaías, Miguel Baptista Nunes and Inmaculada J. Martínez

[20]. Sayago, S., Camacho, L. and Blat, J., 2009. Evaluation of techniques defined in WCAG 2.0 with older people. International Cross-disciplinary Conference on Web Accessibility (W4A-ACM), pp: 79-82, April 20-21, Madrid (Spain). ACM ISBN: 978-1-605558-561-1

Section 3.1 presents an experimental study with 48 older people aimed at exploring different ways of stressing required and optional fields in web forms. Building upon a previous study (see Annex I), which revealed that standard asterisks were not helpful enough for older people to differentiate required from optional fields, and a review on Cognitive Ageing, the effect of Selective Attention in the ability of older people to distinguish between required and optional fields while filling out web forms is examined. Adapted versions of the standard Yahoo! form were designed, replacing standard asterisks by asterisks doubling the original size, icons different from asterisks and by using a binary classification of required and optional fields. The results of the one-way between groups ANOVA test revealed that decreasing the amount of information presented

on forms (binary classification) allows older people to make fewer errors than strategies based on increasing the visual saliency of asterisks (bigger asterisks, icons). This finding challenged the widespread belief that "making things bigger" is an essential requirement for accessibility.

Section 3.2 describes the adaptation of an online web site to its mobile version (PDA Palm OS). In the course of designing a web site for an old-age pensioner association, usability tests carried out with 7 older people had the goal of understanding how the web site should be designed for a mobile device. Unlike a previous experience with young peopleas users, where both online and mobile versions should keep the same navigational scheme, the main requirement of adaptation for older people was to redesign the mobile version of the web site by reducing the number of pages. This is mainly due to age-related changes in cognition, as remembering in which page they were while interacting with the mobile version is more difficult. Small text, which was initially thought of as being a key interaction barrier, was not a problem for the participants. Instead, links were designed in the form of buttons in order to reduce the need of (manual) precision and to avoid mistakes.

Section 3.3 elaborates on the effectiveness of some techniques defined by the accessibility guidelines WCAG 2.0. Usability tests carried out with 12 older people in the course of designing two web sites for two different old-age pensioner associations revealed that the WCAG do not consider carefully enough some of their needs. Keyboard-based navigation does not improve web accessibility. Despite difficulties in using the mouse and the likely benefits of shortcuts and the TAB key to reduce precision in clicking on links, older people want to use the mouse. First, their grandchildren and children use the mouse and not the keyboard when being online. Second, shortcuts and TAB increase cognitive demands and make more difficult to read the content of a web page. 'Click here to" links are of great benefit to older people. These links inform them about where to click on and what will happen after clicking. Both are key questions for them. However, these links are not suggested by WCAG.

3.1 How relevant is selective attention in the design of online forms for older people?

The experimental design described in this paper aims to test whether a design strategy based on minimizing cognitive effort through a binary classification of required and optional fields allows older people to make fewer errors (fewer mandatory fields not filled) while filling in online forms than other strategies based on visual enhancement of these elements, such as bigger asterisks or semantic icons. Our findings show that (decreasing) the amount of information displayed, which is directly related to (diminishing) the cognitive effort required, enables older people to make fewer errors than either standard asterisks or other strategies based on increasing the visual perceptual saliency of mandatory fields. These results uncover a serious web accessibility barrier, and suggest that much more attention ought to be paid to selective attention in the design of more accessible online forms for the growing ageing population.

a) Introduction

The purpose of this paper is to present part of our ongoing work on designing online forms for the growing ageing population. We report here on an experimental study, designed to explore the impact of some factors affecting the older adults' ability to select relevant information on the task of distinguishing between mandatory and optional fields while filling in online forms.

Our focus on online forms and selective attention with older adults has two main motivations. First, very little is known about how to design online forms which are accessible for the elderly. By way of illustration, whereas current web accessibility guidelines for older people provide general web design considerations, ranging from typeface, colors, phrasing, animation and video, navigation and consistent layouts, specific and important aspects of the design of online forms, such as widgets, default values and fields layout, have been overlooked. Nevertheless, online forms are used in a large number of web applications, and thus designing more accessible

online forms for the elderly will result in an improvement in web accessibility[15].

Second, an initial pilot study on usability of online forms for the elderly (Sayago & Blat, 2007) uncovered a noteworthy accessibility barrier. We found out that the standard visually-oriented strategy for distinguishing between required and optional fields (asterisks) was much less helpful for older people to fill in online forms than separating these fields into two sections. Taken together, these results were demonstrative of the need for further research on selective attention and online forms.

Cognitive Ageing research (for a review, see Park & Schwarz, 2000) has unearthed several factors that impact on the older adults' ability to select relevant information, such as providing clues (e.g.; left or right), using different sizes in target/non-target elements, and different amounts of information presented on the display. In this paper we aim to explore their impact on online forms by means of an experimental design.

Overall, our findings show that (decreasing) the amount of information displayed, which is directly related to (diminishing) the cognitive effort required, enables older people to make fewer errors (fewer required fields not filled) than standard asterisks or other strategies based on increasing the visual perceptual saliency of mandatory fields (for instance, through bigger asterisks or icons). Let us note that these results are unlikely to provide concrete design recommendations, because this task requires a more integrated and detailed approach. Nevertheless, we hope our results can provide useful hints for future research.

The rest of the paper is organized as follows. We first situate the experimental design in context, describing the pilot study and the process we followed in order to define the experiment. Next, we describe the experimentation. Afterwards, we present and interpret the findings. Finally, we show some conclusions, limitations, implications, and next steps.

---

[15] This lack of attention towards people with special needs in online forms is also underscored by the DIADEM project (http://www.project-diadem.eu/), aiming to produce an assistive web based technology to enable people who suffer from cognitive disability to confidently and successfully interact with online forms.

b) Context and background

During the course of designing a simple website for an old-age pensioner association (Sayago & Blat, 2007), we found out that elderly adults had difficulties filling in online forms. Namely, we realized that standard asterisks, which are commonly used for distinguishing between required and optional fields in online forms, did not seem to help older people select or filter relevant information (required fields). Nevertheless, it seemed to be a cognitive issue, due to the fact the asterisks were visually perceived by the study participants.

To explore initially this hypothesis, we designed two simple online forms. Both had the same number and type of fields. However, the strategy for differentiating between required and optional fields was different in each web form (standard asterisks, two sections: required and optional). Seven elderly Spanish adults ranging in age from 65 to 74 took part in this evaluation. All participants suffered from normal age-related changes in functional abilities, such as age-related declines in vision (e.g.; myopia and astigmatism) and manual dexterity (e.g.; arthritis). The results pointed out that the binary strategy led to fewer results. Nevertheless, the results were inconclusive, on the grounds that we worked with a handful of older people and with a very simple online form. The reader is referred to (Sayago & Blat, 2007) for a further description of our pilot study.

These results uncovered a significant web accessibility barrier. The task of differentiating between mandatory and optional fields is often conducted while filling in online forms. Nevertheless, the standard design strategy for making such a distinction turned out to be of little or no use for older people. Thus, we elected to explore it in more detail. To undertake this follow-up experimentation, we had to answer several research questions, which guided the experimental design defined in the following section.

Is selective attention age-sensitive? What are the most important factors that impact on selective attentional tasks with older people? A close inspection to relevant literatures in cognitive ageing (Madden & Plude, 1993; McDowd & Shaw, 2001; Park & Schwarz,

2000; Rogers & Fisk, 2001) showed that selective attention is age-sensitive, being providing clues (e.g.; left or right), using different sizes in target/non-target elements and different amounts of information presented on the display three factors with a well-documented effect on the ability of older people to select relevant information.

How can these factors be extended to online forms? This is a critical but largely unexplored question. On the one hand, in our review we found out that there is a need to "extend the study of (selective) attention from well-controlled laboratory environments to the complexity of the outside world" (Rogers & Fisk, 2001, pp: 278). Nevertheless, on the other hand, how to do this extension in the realm of online forms depends on many factors, such as the large variety of online forms and the complexity of user interface design considerations. In addition, as stated earlier, this question has been largely overlooked as yet. In light of this situation, we decided to adopt a pragmatic approach by ignoring graphic design aspects of online forms and some design considerations such as how to divide mandatory and optional fields without breaking the conceptual structure of online forms, which added a high level of complexity to our experimentation.

There are lots of web forms. We concentrated on online forms to create WebMail accounts. This decision was inspired by studies reporting on online activities conducted by older people, pointing to emailing as one of the most frequently done by elderly adults (Goodman & Syme & Eisma, 2002; Larra, 2004). Amongst a sea of web forms to create a WebMail account, we focused on the form to create a Yahoo! WebMail account, which is also used by others widely known WebMails, such as AOL, commonly discussed in the forum about e-mails in SeniorNet[16].

c) Experimental design

Building on our pilot study, the experimental design described herein is intended to test whether a design strategy based on minimizing cognitive effort through a binary classification of required and optional fields allows older people to make fewer

---

[16] http://ww.seniornet.org, retrieved in 2008

errors (i.e. few mandatory fields not filled) than other strategies based on visual enhancement of these elements. The visually-oriented strategies evaluated are: (i) standard asterisks, (ii) bigger asterisks and (iii) semantic icons. In light of our earlier results, we did not expect to find significant differences amid the visually-oriented strategies, as they do not to reduce the amount of information displayed.

The hypotheses tested in this experimental design are defined below:

- H1. A design strategy based on minimizing cognitive effort through a binary classification of required and optional fields allows older people to make fewer errors than other strategies based on visual enhancement of these elements. (See contrast 1, Figure 5).

- H2. Visually-oriented design strategies for distinguishing between required and optional fields based on different types of visual cues (e.g. asterisks and semantic icons) are equivalent. (See contrast 2, Figure 5)

- H3. Visually-oriented design strategies for distinguishing between required and optional fields based on different sizes of the same visual cue (e.g. normal and bigger asterisks) are equivalent. (See contrast 3, Figure 5)

48 older people ranging in age from 65 to 74, with normal age-related changes in functional abilities[17], participated in this study. They were recruited in 4 digital literacy courses run by the authors of this paper in Àgora, an association within an adult school in Barcelona (Spain).

In order to ascertain the level of familiarity of the participants with online forms, we asked them about that during the first sessions of the courses. Participants with no experience with online forms outnumbered those who were familiar with them. Only 8 older

---

[17] By normal age-related changes in functional abilities we mean typical declines in sight, hearing, cognition and mobility brought about by the normal process of ageing, without making older people unable to carry out daily activities on their own.

people had used online forms prior to taking the courses, to create their email accounts. None of the rest of the participants had encountered online forms before. This fact can be held up as an example that is in line with studies reporting on a digital divide between older and young or middle-aged people (e.g.; Larra, 2004).

To get rid of the familiarity variable, the participants with previous experience with online forms were divided randomly into the four experimental conditions used in this study, and described in the Procedure section.

Four modified versions of the standard Yahoo! form to create a Yahoo! WebMail account have been evaluated. These web forms are designed in Spanish. A translated version into English of those keywords which can help non-Spanish readers understand the forms is provided in the following description.


**Figure 3: Standard form and adapted version with bigger asterisks**

Figure 4: Adapted versions using icons and binary classification

The standard Yahoo! form online form is depicted in Figure 3(left). Asterisks indicate mandatory fields. The form in Figure 3(right) uses bigger asterisks. Their size is 12pt, which doubles the size of asterisks in the standard form, and also follows the design recommendations available in web accessibility guidelines for the elderly (e.g.; Echt, 2002). The form in Figure 4 (left) uses icons in order to distinguish between required and optional fields. While the design of icons conveying best the meaning of mandatory is complex, we have relied on a social acceptance criterion. We did that by using Flickr[18]. Having parsed the whole repository, we came to the conclusion that mandatory is socially associated with words which carry this meaning, rather than images. Thus, we designed two icons, with the words "Obligatorio rellenar" (in English, required to be filled) and "Opcional" (in English, optional). Finally, the form in Figure 5 (right) uses a binary classification. Required and optional fields are separated into two sections, "obligatorio rellenar" (in English, required to be filled) and "Opcional" (in English, optional).

The modified forms are all consistent with the original form in terms of both the number and type of fields. However, they do not have the same graphic design, as indicated earlier.

---

[18] Yahoo! Flickr is a social repository of pictures and images used by people all around the world. http://www.flickr.com, retrieved in 2008.

Four evaluation sessions were conducted (twelve users per session). Two participants had some experience with computers, whereas the rest of users had little acquaintance with them. All the sessions took place in an environment which was natural for the study participants, the room with computers dedicated to the courses in La Verneda.

Prior to the test, the participants were informed about the objective of the session. They were told that they would be asked to fill in an online form, and the information introduced in that form would be kept safely. Next, a 15 minute hands-on introduction to forms was given, so that those participants who had never filled in one would become familiar with them. All the forms were online, to simulate real use. The URL of each form was distributed amongst the participants. This distribution was carried out as follows. Each web form was filled in by 3 participants in every session, and each participant only filled in one web form. Participants filling in the same web form did not sit one next to another.

During the test, the participants were first asked to access to the online form that has been assigned to each of them previously. Second, the participants were asked to fill in the web form displayed on their computers individually, and informed about the end of the activity. Having filled out the form, a message (a pop-up menu) would appear, indicating either success or failure. If failure, the message would inform the participants about those required fields that had not been filled. And, consequently, they had to fill them again. In the event of success, the system would show a 'congratulations' message. The participants were also informed that they would not receive support from us as we aimed to simulate real interactions, unless we identified that they were getting very nervous or anxious. The participants were informed that they had 30 minutes to complete the task, which we thought was enough time for them to do this activity.

To record automatically the total number of required fields not filled, a simple Javascript procedure was implemented in each form. We chose not to rely on questionnaires, due to documented problems in conducting them with the elderly (e.g. Schwarz & Knäuper, 2000). If a participant needed more than one attempt to fill in his or her online form, we computed the errors made in each

attempt. This procedure only checked whether all the required or mandatory fields had been filled. Neither misspelling errors nor fields filled correctly were taken into account, because these aspects were not related to the aim of our test.

A one-way between-groups ANOVA was conducted in order to analyze the results. The independent variables correspond to four design strategies for distinguishing between required and optional fields: (i) standard asterisks, (ii) bigger asterisks, (iii) binary classification and (iv) semantic icons. The dependent variable is the number of errors, measured by the number of required fields not filled. Three planned contrasts were carried out (see Figure 5), which correspond to the three hypotheses previously defined. SPSS version 15 was used to carry out the analysis.
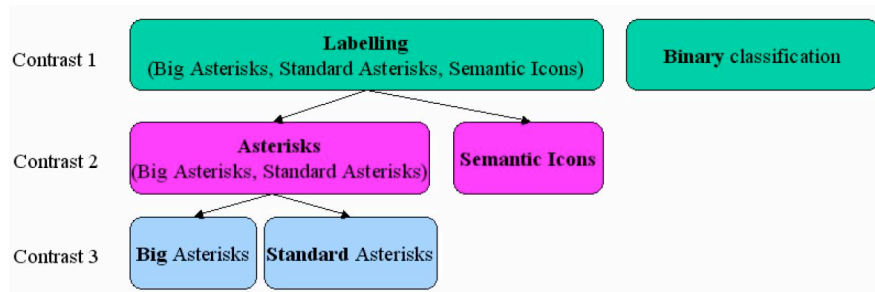
Figure 5: Planned contrasts

d) Findings

Table 3 shows the number of errors made by the study participants in the four web forms. The total number of required fields not filled in the three visually-oriented strategies (asterisks, bigger asterisks and semantic icons) is similar. In addition, the vast majority of participants made at least one error. Interestingly, these results differ considerably from those obtained in the binary classification, however. The total number of errors is reduced significantly (from 14 or 15 in the visually-oriented strategies to 1), in addition to the percentage of participants who did not fill required fields (only 1 participant made 1 error).

	Asterisks		Bigger asterisks		Semantic icons		Binary classification
User 1	0	User 13	2	User 25	2	User 37	1
User 2	2	User 14	3	User 26	2	User 38	0
User 3	0	User 15	0	User 27	1	User 39	0
User 4	2	User 16	0	User 28	1	User 40	0
User 5	1	User 17	3	User 29	1	User 41	0
User 6	0	User 18	1	User 30	1	User 42	0
User 7	0	User 19	1	User 31	1	User 43	0
User 8	2	User 20	0	User 32	1	User 44	0
User 9	2	User 21	1	User 33	0	User 45	0
User 10	2	User 22	1	User 34	2	User 46	0
User 11	1	User 23	2	User 35	1	User 47	0
User 12	2	User 24	1	User 36	2	User 48	0
Total	14		15		15		1

Table 3: Summary of findins of the experimental design

Is the main effect of the type of strategy on the number of errors significant? The statistical analysis points out that there is a significant effect of the type of strategy to distinguish between required and optional forms on the number of required fields not filled, $F(3, 47)=3.409$; $p<0.03$.

Are the hypotheses confirmed or rejected? As detailed below, the three hypotheses are confirmed:

- Hypothesis 1. A design strategy based on minimizing cognitive effort through a binary classification of required and optional fields allows older people to make fewer errors than other strategies based on visual enhancement of these elements, $t(44)=3.186$; $p<0.005$ (one-tailed).

- Hypothesis 2. Visually-oriented design strategies for distinguishing between required and optional fields based on different types of visual cues (e.g. asterisks and semantic icons)

are equivalent, t(44)=-0.141; p<0.9 (one-tailed). This means that older people made a similar number of errors independently of the type of visual cue, either the standard asterisk or a completely different icon.

- Hypothesis 3. Visually-oriented design strategies for distinguishing between required and optional fields based on different sizes of the same visual cue (e.g. normal and bigger asterisks) are equivalent, t(44)=-0.244; p<0.9 (one-tailed). This indicates that older people made a similar number of errors independently of the size of the asterisks.

It is worth mentioning that Post Hoc tests reinforce these results. With respect to hypothesis 1, differences between the binary classification and each labeling strategy are significant ([Binary Classification vs Standard Asterisks, p =0.04]; [Binary Classification vs Bigger Asterisks, p=0.04]; [Binary Classification vs Semantic icons, p=0.001]). As far as hypothesis 2 and 3 are concerned, differences amongst the three labeling strategies are not significant ([Standard Asterisks vs Bigger Asterisks, p =0.997]; [Standard Asterisks vs Semantic Icons, p=0.993]; [Semantic Icons vs Bigger Asterisks, p=1.0]).

These results show that the amount of information displayed on the display is more relevant for older people to distinguish better between required and optional fields than neither the size of standard asterisks nor the type of visual clue, despite the fact that boosting the visual saliency of user interfaces elements can be thought to be a much better strategy. These findings also suggest that much more attention ought to be paid to selective attention in online forms, in that the standard asterisk strategy does not seem to be the best approach.

e) Conclusions

In this paper we have presented an experimental design aimed to explore some aspects of selective attention in the design of online forms for elderly adults. Building upon a previous experience, we have focused on the task of distinguishing between mandatory and optional fields, which is often carried out while filling in online forms, and evaluated the impact of factors affecting older adults' selective attentional capabilities on the number of required fields

not filled by older people in modified versions of the Yahoo! form to create a WebMail account.

The main finding of our experimentation is that (decreasing) the amount of information displayed, which is directly related to (diminishing) the cognitive effort required, allows older people to make fewer errors (fewer required fields not filled) than standard asterisks or other strategies based on increasing the visual perceptual saliency of mandatory fields, for instance, through bigger asterisks or icons. The results also point out that the three visually-oriented strategies tested are equivalent (i.e. differences in the number of errors were not significant), which gives ammunition to the main result.

The findings reported herein are conditional on the limitations of our study. First, the question of how to extend findings from selective attention research on ageing to the design of online forms for the elderly is very complex and largely unexplored. In our study, we have worked with online forms with poor graphic design, which might make them look unrealistic. The extension of factors affecting older people's attentional capabilities to strategies for distinguishing between required and optional fields is simple, and no alternatives have been tested. For instance, the fact that older people made more errors in the web form with semantic icons than in the web form with standard asterisks might have been due to the fact that they did not understood the icons. Second, the number of optional fields in the Yahoo! form is very small in comparison to the number of mandatory fields (only 1 field is non-required). Therefore, it poses the question of how practical or realistic would the binary classification strategy be in more complex online forms. For instance, there might be fields that are contextually linked to others, such as an apartment number and the street name, where the separation will probably make little sense. Third, the procedure to log participants' interactions was developed for the specific web forms designed in this study, which might constrain its use for future research.

Despite these limitations, we hope our study has contributed to enhance our understanding of designing better online forms for older people. Overall, our findings point out that much more attention should be paid to selective attention, due to the fact that

the standard asterisk strategy does not seem to be the best approach in order for older people to distinguish between required and optional fields, despite being widely used. This is a noteworthy accessibility barrier, which warrants much more research.

We are currently working on another experiment in order to get a deeper insight into the results presented in this paper. We have designed several modified versions of the form to create a Hotmail account and the online form to book flights in Vueling.com (a Spanish flight line). We have not changed the graphic design of the original forms in the modified versions, and developed several extensions for the selective attentional factors considered in this study. We are developing a platform, which will help us to automatically store and analyze the number of errors made by older people while filling in online forms. We expect to carry out a number of tests in the near future.

f) References

Echt, K.V. (2002) Designing Web-Based Health Information for Older Adults: Visual Considerations and Design Directives. in Morrell, R.W. ed. Older Adults, Health Information, and the World Wide Web, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp: 67-89.

Goodman, J. & Syme, A. & Eisma, R. (2002) Older Adults' use of computers: A survey. in Proceedings Volume 2 of the 16th British HCI Conference, London.

Larra, R.M.d. (2004) Los Mayores en la Sociedad de la Información: situación actual y retos de futuro, Fundación AUNA, Madrid (Spanish report).

Madden, D.J. & Plude, D.J. (1993) Selective Preservation of Selective Attention. In Cerella, J., Rybash, J., Hoyer, W. and Commons, M.L. eds. Adult information processing: limits on loss, Academic Press, San Diego, California, pp: 273-295.

McDowd, J.M. & Shaw, R.J. (2001) Attention and Aging: A Functional Perspective. In Craik, F.I.M. and Salthouse, T. eds. The

Handbook of Aging and Cognition, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp: 221-293.

Morrell, R. W. & S. R. Dailey, et al. (2003). Applying Research: The NIHSeniorHealth.gov Project. Impact of Technology on Successful Aging. N. Charness and K. W. Schaie. Springer Series Societal Impact on Aging, New York, pp: 134-162.

Park, D. & N. Schwarz, Eds. (2000). Cognitive Aging: A Primer Aging, Taylor & Francis, Philadelphia.

Rogers, W. & Fisk, A.D. (2001) Understanding the Role of Attention in Cognitive Aging Research. in Birren, J.E. and Schaie, K.W. eds. Handbook of the Psychology of Aging, Academic Press, San Diego, California, pp: 267-282

Sayago, S. & Blat, J. (2007): Some aspects of designing accessible online forms for the young elderly. in Third International Conference on Web Information Systems and Technologies. Barcelona (Spain). March 3-6. INSTICC Press. ISBN: 978-972-8865-78-8, pp: 13-18.

Schwarz, N. & Knäuper, B. (2000) Cognition, aging, and self-reports. in Park, D. and Schwarz, N. eds. Cognitive Aging: A Primer, Taylor & Francis, Philadelphia, pp: 233-253.

g) Acknowledgements

3.2   Adapting an online website to a Palm OS with young elderly people

This short paper reports on the adaptation of an online website to a Palm OS with young elderly people and compares the results to a previous experience with young adults. Despite the fact that society is aging and the need for translating many online websites to mobile

formats, little research has been carried out with the elderly so far. Nevertheless, mobile web accessibility can open up a wide range of opportunities to them. Within the context of designing a multimodal website for elderly Spanish adults, this paper initially explores the requirement of adaptation of two key aspects, navigational structure and visual appearance of links. The young elderly are able and willing to use PDAs, contrary to negative stereotypes. Nevertheless, mobile interfaces need to take into account their special needs, which mainly stem from agerelated changes in functional abilities. Independently of experience with PDAs, the young elderly have great difficulties clicking on standard links, unlike young people. Designing links in the form of buttons overcome them because less precision is required in order to click on links. The young elderly also seem to prefer different navigational structures in mobile and online versions, as opposed to young people. The young elderly benefit from very simple navigational structures, which mainly consist of a small number of pages and clicks.

a) Introduction

Most of the online websites have been designed without contemplating the possibility of being accessed through mobile phones or PDAs. Nevertheless, people are no longer required to sit on a chair in front of a computer in order to access to the web. Due to the characteristics of mobile phones and PDAs (e.g.; small visual space), along with differences in usage patterns with respect to PCs (Palm OS User Interface Guidelines 2006), there is widespread agreement that online websites need to be translated to mobile formats. Nowadays, this issue is being explored from several directions (e.g. (Chen, Ma et al. 2003); (Hinz, Fiala et al. 2005)). Nevertheless, despite revolutions in longevity and research on mobile interaction with the older population (e.g.; (Mikkonen, Väyrynen et al. 2002); (Ziefle and Bay 2004)), the requirement of adaptation of online websites to mobile formats with the elderly has received little attention.

In this short paper we report on the translation of an online website to a Palm OS with young elderly adults. Namely, this paper initially explores the requirement of adaptation of two key aspects: navigational structure and visual appearance of links. This study was carried out in the design and evaluation of a simple multimodal

website for an old-age pensioner association in Molins de Rei[19]. The details of this website are described in (Sayago and Blat 2006). Several prototypes were evaluated with PDA illiterate elderly people. The findings were also compared to a previous experience (Sayago, Navarrete et al. 2003), where we explored the adaptation of an online website to a Palm OS with young people (18-25). The comparison aimed to identify unique user interface requirements of the young elderly. In working towards this goal, we decided to take control over PDA expertise.

We decided to focus on young elderly people, who are defined in the literature on The Psychology of Aging as adults ranging in age from 65 to 74, because they (i) outnumber the oldest-old and the old-elderly and will also be greater in number in the near future (Larra, R. M. d. 2004); (ii) suffer from minor age-related declines in functional abilities and (iii) are more likely to have acquaintance with ICT than the oldest-old or the old-elderly.

b) Overview of the study

Four young elderly users ranging in age from 65 to 74 with no experience in PDAs took part in this study. These users also participated in the design of the website for the old-age pensioner association. With the aim of identifying requirements of the elderly and comparing them to the requirements of "ordinary" users, such as young people, we decided to take control over PDA expertise. To this end, all the participants were trained in the use of PDAs during 30 minutes. They were required to add real appointments to the virtual agenda (e.g.; to pick my granddaughter up after school) and to access to some web pages through a Palm OS (e.g.; http://www.ya.com). The training session was carried out prior to the study.

We concentrated on two basic and common aspects of translating the user interface of online websites to mobile formats: (i) navigational structure and (ii) visual appearance of links. Content adaptation was not addressed. With respect to the first aspect, building on documented age-related reductions in memory (Fisk, Rogers et al. 2004) and the results of our previous experience with

---

[19] A little town near Barcelona (Spain).

young people, we aimed to identify whether the mobile version should preserve the same navigational structure as the online website (consistency). Concerning the visual appearance of links, in light of well-known age-related changes in vision, manual dexterity and difficulties elderly people experience in using the mouse (Fisk, Rogers et al. 2004), we intended to evaluate whether links in the form of buttons[20] are easier to use than traditional underlined links.

The prototype presented in Figure 6 follows the same navigational structure as the online website (see Figure 6, right), with the exception of direct links amongst first level web pages. Unlike the online version, each first level web page is solely linked to the Home Page. Therefore, for instance, if a user is on the Activities page and wants to go to the Excursions page, he or she has to go back to the Home Page and click on Excursions. We decided to make this minor change in order to make the most of small visual space by showing as much information as possible in addition to minimizing the number of links on each screen.
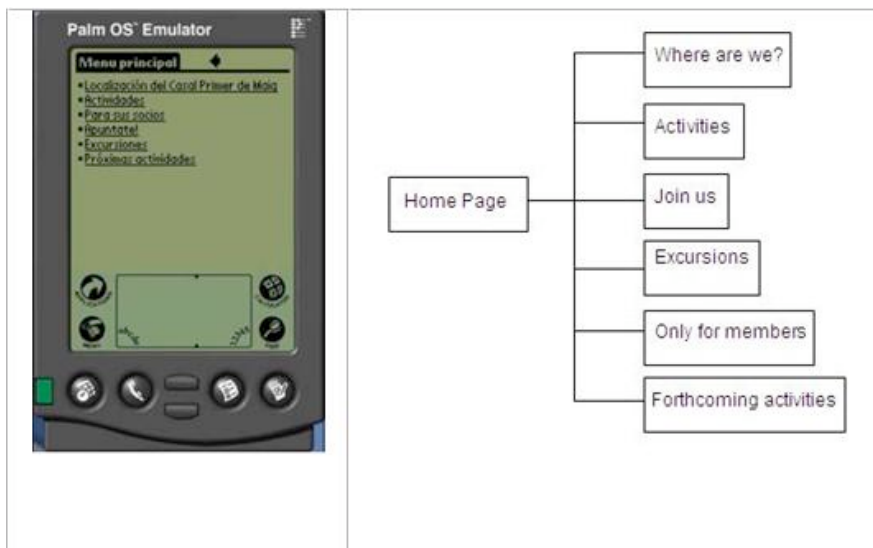

Figure 6: Prototype using the same navigation scheme

The prototype presented in Figure 7 does not follow the same navigational structure as the online website. This prototype only

---

[20] As stated in (Palm OS User Interface Guidelines) , links can be displayed in the form of buttons in Palm OS devices.

consists of the Home Page. It shows all the information and is structured into sections (left), which in turn correspond to the first level pages of the online website (right). This prototype was thought to be easier to use because of the reduction in the number of pages.
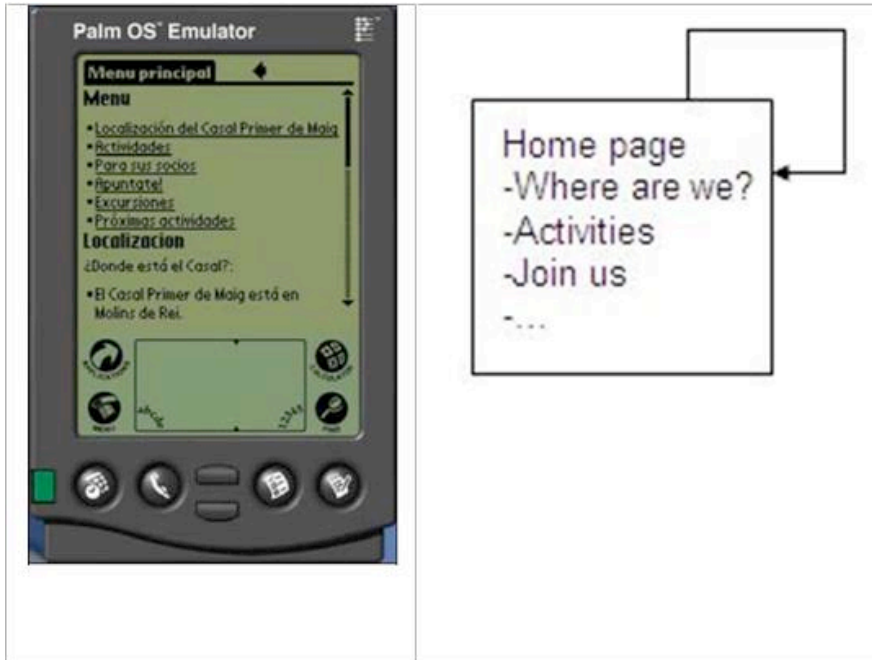
Figure 7: Prototype using a different navigational scheme

The evaluation procedure consisted of a usability test (Rubin 1994). Prior to the test, a post-test questionnaire and a semi-structured interview were designed in order to gather usability data. During the test, participants were asked to look for information regarding "activities" and to think-aloud while they were accomplishing this task. After the test, participants were interviewed and required to fill in the post-test questionnaire in order to know which version had been the easiest to use and why.

All of them pointed out that the second prototype, which does not follow the same navigational structure as the online website, was the easiest to use. A reduced number of pages and clicks (they used the vertical scroll bar) were noteworthy requirements. All the users had great difficulties in clicking on traditional underlined links because of great precision. In addition, they got lost several times in

the first prototype, despite the small number of pages. These results initially confirm our research hypothesis.

Interestingly, elderly and young people seem to have different requirements. In a previous experience (Sayago, Navarrete et al. 2003), we found that young adults (18-25) prefer to have the same navigational structure in both web and mobile versions. Basically, young users did not want to learn two different navigational structures in order to use the same website.

In light of the results of the previous scenario, along with difficulties in clicking on standard links with the mouse and documented age-related reductions in vision and manual dexterity, we decided to evaluate the usability of showing links in the form of buttons (see Figure 8), which were thought to be easier to click on. Both the evaluation procedure and the test task were the same as in the previous scenario.
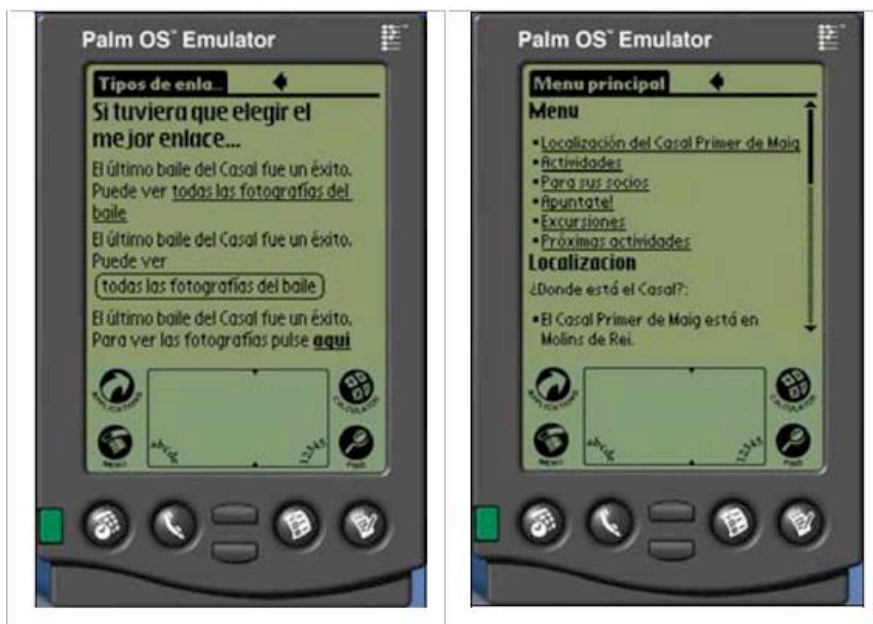


Figure 8: Prototypes for evaluating links

All the users expressed a strong preference towards links in the form of buttons. Clicking on them was much easier than clicking on traditional underlined links since the active area is bigger (less

precision). These results initially confirm our research hypothesis. In addition, as compared to young people, the results of our previous experience show that young users did not experience difficulties clicking on standard links. Indeed, showing links in the form of buttons was not a requirement for them. These results initially confirm our hypothesis, which suggested that traditional links are difficult to use by elderly people.

c) Summary of findings, limitations and outlook

This short paper has aimed to show initial requirements for translating the user interface of an online website to PDAs with the young elderly. They are able and willing to use PDAs, contrary to negative stereotypes and beliefs. Nevertheless, the young elderly have to perceive the usefulness of PDAs, since they think this technology is not aimed at them and they are used to getting by on traditional notebooks and, mobile interfaces need to meet their special needs.

The young elderly have great difficulties clicking on standards links. These difficulties are likely to stem from age-related changes in vision, manual dexterity and small visual spaces. This paper shows that links in the form of buttons are easier for the elderly to use because less precision is required to click on links. The young elderly also seem to prefer different navigational structures in mobile and online versions, unlike young people. Elderly adults benefit from mobile versions with very simple navigational structures, with a small number of pages and clicks. This requirement of adaptation will probably stem from the difficulties in clicking on links along with age-related changes in memory and their impact on navigation (e.g.; to remember previous visited pages).

The requirement of adaptation of online websites to mobile formats with the elderly is a new and fertile research area, and there are many unanswered questions. Due to the impact of serious age-related reductions or disabilities in functional abilities on interacting with mobile devices, different results might be achieved if users fall into the categories of the oldest-old or the old-elderly. More users and a better way for controlling PDA expertise should be contemplated in following studies in order to obtain more

meaningful results. Furthermore, although a number of hypotheses regarding the impact of age-related changes in functional abilities on the requirement of adaptation have initially been confirmed, much more experiments are needed. In addition to this, other strategies to adapt online websites to mobile formats, such as content and automatic adaptation, which might be worth exploring with the elderly, have not been evaluated.

We are currently researching on guidelines and usability evaluation methods in the design of online websites and mobile applications for communication.

d) Acknowledgements

e) References

Palm OS User Interface Guidelines (2006). Guidelines available at: http://www.palmos.com/dev/support/docs/ui/UIGuide_Front.html.

Chen, Y., W.-Y. Ma, et al. (2003). Detecting Web Page Structure for Adaptive Viewing on Small From Factor Devices. WWW 2003, Budapest, Hungary, pp: 225 - 233.

Fisk, A. D., W. A. Rogers, et al. (2004). Designing for older adults. Principles and Creative Human Factors Approaches, CRC Press.

Hinz, M., Z. Fiala, et al. (2005). Personalization-Based Optimization of Web Interfaces for Mobile Devices. MobileHCI 2004. pp: 204–215.

Larra, R. M. d. (2004). Los Mayores en la Sociedad de la Información: situación actual y retos de futuro. Madrid, Fundación AUNA.

Mikkonen, M., S. Väyrynen, et al. (2002). "User and Concept Studies as Tools in Developing Mobile Communication Services for the Elderly." Personal Ubiquitous Computing 6; pp: 113-124.

Rubin, J. (1994). Handbook of usability testing. How to plan, design, and conduct effective tests, John Wiley & Sons.

Sayago, S., T. Navarrete, et al. (2003). Técnicas de Ingeniería de Usabilidad y metodología de diseño conceptual en algunas aplicaciones informáticas. IV Congreso Internacional de Interacción Persona-Ordenador, Vigo, España.

Sayago, S. and J. B. (supervisor) (2006). Some aspects of ICT accessibility, usability and design methods with the young elderly. MPhil. Department of Technology. Barcelona (Spain), Universitat Pompeu Fabra.

Ziefle, M. and S. Bay (2004). Mental Models of a Cellular Phone Menu. Comparing Older and younger Novice Users. MobileHCI 2004, Springer-Verlag. pp: 25-37.

3.3 Evaluation of some techniques defined in WCAG 2.0 with older people

Although WCAG 2.0 offer techniques for making web content more accessible to all people, very little is known about how these techniques enhance web accessibility for older people. This paper addresses two techniques, keyboard-based navigation and design of links purpose. They are evaluated by using simple prototypes in the course of designing two websites for old-age pensioner associations. Participants (N=11) ranged in age from 65 to 80 years old and were familiar with web concepts. The results indicated that keyboard-driven navigation did not improve web accessibility. Older people preferred to use the mouse because of inclusiveness, despite their difficulties using it. 'Click here to' links helped participants clarify where they had to click and what would happen after clicking, despite not being suggested by the WCAG 2.0. Click-able pictures should resolve to full size renderings of those images rather than opening a new web page. These findings suggest that WCAG 2.0 do not consider carefully enough some important needs of older people. The paper discusses some alternatives for taking them into account.

a) Introduction

"The creation of written guidelines and standards addressing web and internet accessibility is a key reason why the web is on its way to becoming more accessible" ([4] pp: 47). The Web Accessibility Initiative (WAI) is responsible for the World Wide Web Consortium's commitment to web accessibility for all people. The WAI has created a number of guidelines for content design, authoring tools and user agents. In this paper we concentrate on the WCAG 2.0 [7]. These guidelines provide us with a wide range of techniques for making web content more accessible. Nonetheless, very little is known about how these techniques enhance web accessibility for older people. Population ageing and the barriers that older people encounter going online, due to age-related changes in functional abilities and a general lack of experience with the web, seem to call for exploring WCAG 2.0 with them.

This paper aims to elaborate on the efficacy of WCAG 2.0 with older people by addressing two techniques: keyboard-based navigation (within Guideline 2.1) and design of links purpose (within Guideline 2.4). These techniques were explored in the course of designing two websites WCAG complaint for different old-age pensioner associations. Prototypes using these accessibility techniques were designed and evaluated with 12 older people familiar with the web. The results of these evaluations informed the design of the final websites.

Three main results were obtained. First, despite the fact that participants had more difficulties using the mouse than the keyboard, keyboard-based navigation (using the TAB key and shortcuts) was much less helpful than mouse-driven navigation. Participants wanted to use the same technologies as their children and grandchildren use to navigate online, and the keyboard is not used to click on links. Second, 'click here to' links improved accessibility when links were embedded in paragraphs by allowing older people to answer two key questions: Where do I need to click? What information would appear after clicking? Nevertheless, 'click here to' links should be avoided in web design (e.g.; [3]). WCAG 2.0 advices us not to use 'click here' links, but does not recommends using 'click here to' links, however. Links corresponding to main sections of websites needed not be designed in the 'click here to' style, as the standard underlined style was enough for participants to click on them. Finally, click-able images

should resolve to full size renderings of those images rather than opening a new web page.

Thus, it appears from these results that WCAG 2.0 does not contemplate carefully enough some accessibility needs of older people. The results suggest that special consideration ought to be given to navigational mechanisms. These results can also help to inform extensions or adaptations of WAI guidelines, such as those being carried out within the WAI-AGE project [6].

Section b) describes the evaluations of the WCAG 2.0. Section c) presents the results. Section d) shows how these results inspired the design of the final web sites. Finally, section e) discusses the results and outlines some future research perspectives.

b) Evaluations of the WCAG 2.0

While designing a web site for an old-age pensioner association [5] we found out that older people had serious difficulties in clicking on links. Participants (N=7; 65 to 80 years of age) rated the standard underlined representation of links as the easiest way to both recognize and click on them. Nevertheless, the lack of consistency in the design of links in websites targeted at older people[21] made it difficult for them to know when to click. Participants did not have difficulties reading the content of these web pages, using 10-12 pt for text size. Instead, links were not always designed in the standard way, so participants could not capitalise on their previous knowledge about how links are or should be displayed. In addition to this, participants paid much more attention to the underlined aspect of the links than other clues, such as the hand that appears when the mouse cursor is over them.

These results encouraged us to find ways of designing links that are accessible to older people. To this end, we elected to explore techniques defined in guidelines promoted by WCAG 2.0. In particular, we focused on design of links purpose (within Guideline 2.4) in order to explore several ways of displaying links. We also focused on keyboard-based navigation (within Guideline 2.1) so as

---

[21] http://www.jubilatas.com/; http://www.portaltercera.com.ar/;
http://www.tercera-edad.org/

to identify which of the two most standard input devices (the mouse and they keyboard) helped older people most to click on links.

The explorations were carried out in the course of designing two websites for different old-age pensioner associations. We could have carried out these explorations as single and independent experiments. However, we thought that integrating these experimentations into real scenarios, as well as conducting them in different settings, would be the best approach to identify how WCAG 2.0 techniques enhance web accessibility to older people. Let us also note that the websites conformed to WCAG 1.0[22].

Participants (N=12) were older Spanish people living in Barcelona (Spain). They ranged from 65 to 80 years old. All of them experienced normal age-related changes in functional abilities (vision, hearing, cognition and mobility). These changes did not affect their ability to carry out ADL (Activities of Daily Living) or IADL (Instrumental Activities of Daily Living) on their own. Participants were familiar with web concepts and navigation such as link, web pages and when to click.

We recruited 7 older people in Casal 1er de Maig[23] (hereinafter will be cited within the paper as CM) and 5 older adults in Joan Casanelles[24] (hereinafter will be cited within this text as JC).

We designed two simple prototypes for design of links purpose and keyboard-based navigation. We opted to work with simple web pages so as to keep our research as much focused as possible.

Figure 9 and 10 shows the prototypes for the exploration of design of links purpose. Both prototypes show different ways of designing

---

[22] WCAG 2.0 was in a draft state when the experimentations were carried out (2006-2007). Nevertheless, the aspects explored in them are a cornerstone of both versions. WCAG 2.0 builds upon WCAG 1.0 [7], and Guideline 2.1 in WCAG 2.0 is related to 9.2 in version 1.0; and Guideline 2.4 in version 2.0 is related to 9.4 and 13.1 in WCAG 1.0. See [7] for further details about the relationship between WCAG 1.0 and 2.0.

[23] Old-age pensioner association located in Molins de Rei, a town near Barcelona (Spain).

[24] Old-age pensioner association located in the Clot – Aragó, a neighbourhood of Barcelona.

the same link. In Figure 9, the link is "You can see all the photos which were taken in the last party". We selected this link because CM was interested in showing the photos of the events and parties they organised on their website. In the first sentence, the link corresponds to the (grammatical) object, "all the photos". In the second sentence, the link encompasses the main verb and the object, "see all the photos". The last two sentences use the words "click here". In the third sentence, the link corresponds to "here". In the fourth sentence, the link corresponds to the whole sentence: "click here to see all the photos which were taken in the last party".
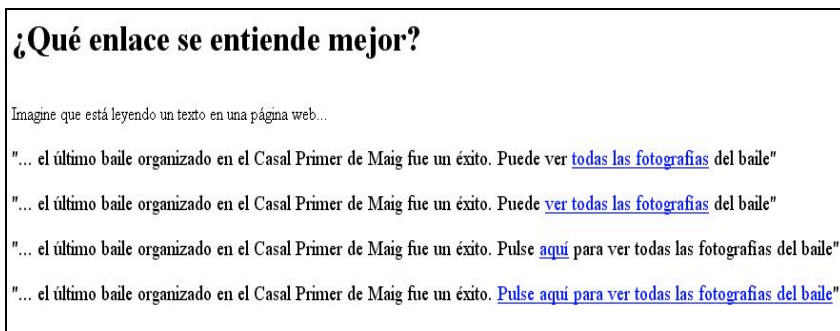
Figure 9: Prototype for evaluating the design of links purpose (1)

Figure 10 shows several different ways of designing a link in order to enlarge a photo of the paintings drawn by the participants in JC. The main difference between prototype B and prototype A is that we added the possibility of clicking over a picture, which is a frequent navigational strategy in web sites that we did not contemplate in the first prototype.
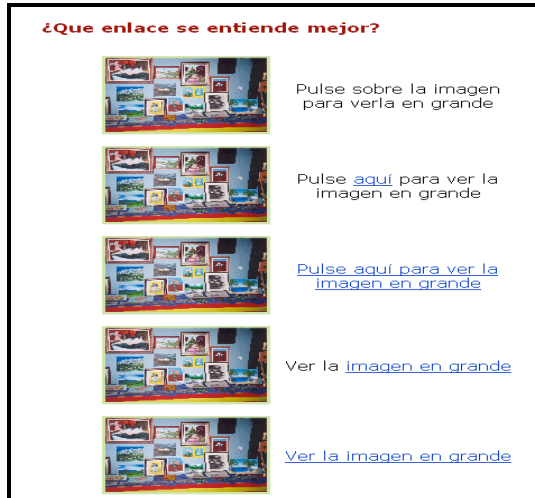
Figure 10: Prototype for evaluating the design of links purpose (2)

Figure 11 and 12 shows the prototypes for the evaluation of keyboard-driven navigation. In both prototypes, the web page is divided into several sections. In prototype C, the sections are: news, excursions, funny things about CM and expenses. In prototype D, the sections are: home, activities, about JC, facilities and contact. Each section could be reached by either pressing the TAB button in a logical order or by using keyboard shortcuts (e.g. ALT+1 goes to the first link and so on).
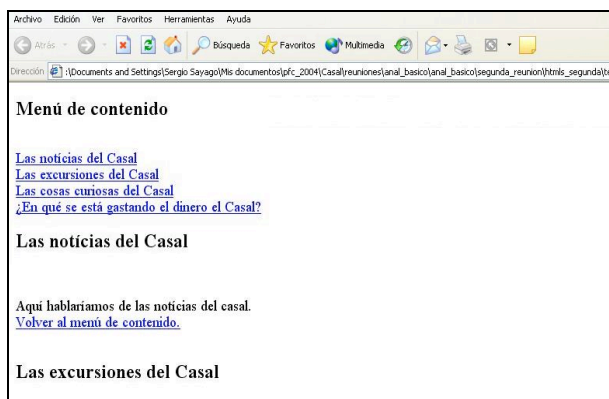
Figure 11: Prototype for evaluating keyboard-driven navigation

Figure 12: Prototype for evaluating keyboard-driven navigation

Let us note that we designed slightly different prototypes because of the real scenarios. We gathered different requirements for designing CM and JC's web sites, two of them being the color and the layout ([1], [5]).

The prototypes were evaluated by using a modified version of the traditional usability testing. Drawing on previous experiences, which are described in [5], typical usability tests in which a single user is doing tasks and thinking aloud at the same time were turned into pair-based evaluations. Interacting in pairs makes older people feel both more relaxed and confident about their skills to solve problems, as well as being a natural way for them to go online. Moreover, older people talk-aloud between themselves instinctively and do not mind being observed.

As shown in Figure 13, prototypes A and C were evaluated in CM. Prototypes B and D were evaluated in JC. Each participant in CM (JC) took part in the evaluation of respective prototypes.

Recommendations	Design of link purpose		Keyboard-based navigation	
Prototypes	A	B	C	D
JC		5		5
CM	7		7	

Figure 13: To be completed

Five usability tests "in pairs" were carried out[25]. Each evaluation session lasted between 30 and 45 minutes. The evaluations were carried out in CM and JC's computers room. For prototypes A and B, participants were asked to click on the link that they found it easier to understand and recognise. For prototypes C and D, participants were informed about the fact that links were click-able by using the keyboard. These combinations (TAB and ALT + number) were explained to the participants before and during the test. Participants were asked to decide which option was the easiest to use and why. Participants were not recorded in the sessions, since video cameras made them feel very unease. Instead, we wrote down notes about their interactions and comments. Participants were interviewed (in pairs) at the end of the tests. We took notes of their comments. At the end of each interview, we read aloud the notes and asked them to either agree or disagree on them, adding more information if appropriate. The notes were analysed using traditional content analysis [2].

c) Findings

We obtained the same results in both JC and CM evaluations. All the participants showed a strong preference towards the 'click here to' links. The main reasons were: (i) they knew where to click and (ii) they knew which type of information would appear after clicking. *"I click on that link and I do not know what is going to happen. I will be either seeing a MS Word document or reading a web page, you never know. However, if you see click here to do something, this is much clearer. I mean, you know what you have to do. Second, you know what is going happen. Easy, clear (pause) good for old folks!"* [Man 73]

It is also worth noting that "click here to" links avoided misunderstandings when the click-able element was a picture. Participants thought that click-able pictures would allow them to see them in bigger size. They did not expect to see another web page after clicking on a picture. Opening a new web page was expected to happen only after clicking on a (textual) link.

---

[25] In CM: two tests with two users and one test with 3 users. In JC: one test with 2 users and one test with 3 users.

Web navigation through the TAB key did not improve web accessibility. It made it difficult for participants to read the content of web pages because of the sudden jumps between links, *"using the TAB key puts my off visiting the web page because of these vertical movements, which make me difficult to read the whole page"* [Man, 68]. Also, coming back to previously visited sections required a combination of keys (SHIFT + TAB) which were quite difficult to either use or remember, even though they were reminded of them during the tests. Keyboard shortcuts did not improve accessibility either. Participants were not interested in using either shortcuts or the TAB key at all. Instead, all the participants showed a strong preference towards using the mouse. A common theme in the post-test interviews was inclusivity. Participants struggled to use the mouse because their children and adult children used it to access to the web. They barely used the keyboard in order to surf on the web, and thus using other devices would make older people different, in to the participants' book.

d) Informing designs

How can these results inform the design of more accessible websites for older people? In light of the overwhelming preference of participants to 'click here to' links, we designed all links in both websites in this way. Nevertheless, iterative evaluations carried out as the designs progressed[26] pointed out that distinguishing between two types of links was worthwhile: links embedded in paragraphs are not the same as links associated with main sections of websites.

All the participants told us that links in important sections (e.g. Home and Activities) needed not be "click here to" links. Owing to the fact that these links were not embedded in paragraphs and their size tends to bigger than the text in the body of web pages, it was enough for them to see these links underlined. However, when the links were in paragraphs, they had to find a way of distinguishing between click-able and non click-able text. This distinction was difficult to make if non click-able text was underlined – an

---

[26] Following a traditional framework of user-centered design, we involved our users during the design. We did that by running focus groups with versions of the web sites. The evaluation of the web sites is described [1] and [5].

inconsistent used of the underline style of links. 'Click here to' links in paragraphs helped older people to make this distinction easily.

The final design of both web sites displayed links in two ways. As depicted in Figure 14 and 15, links to main sections of the web sites appear underlined. By contrast, links in paragraphs were designed in the "click here to" style.
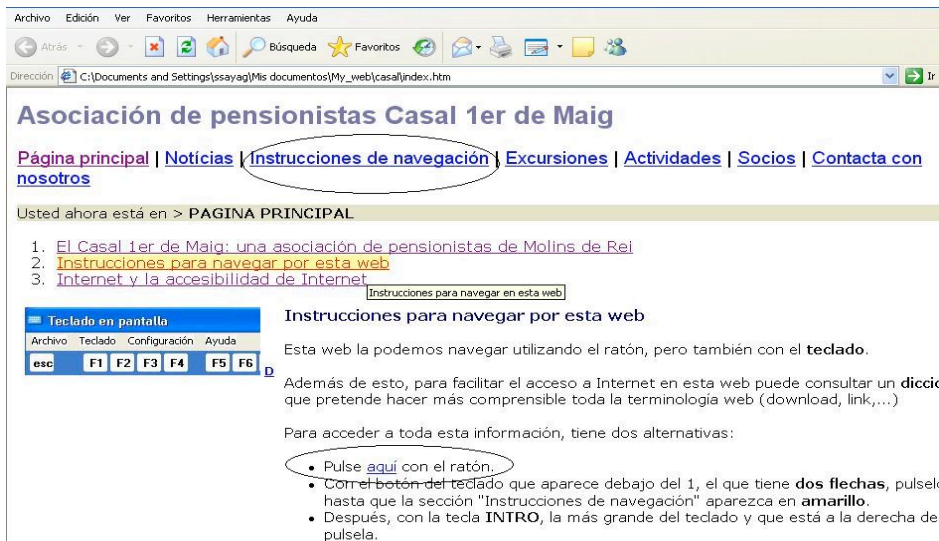
Figure 14: Final prototype for CM
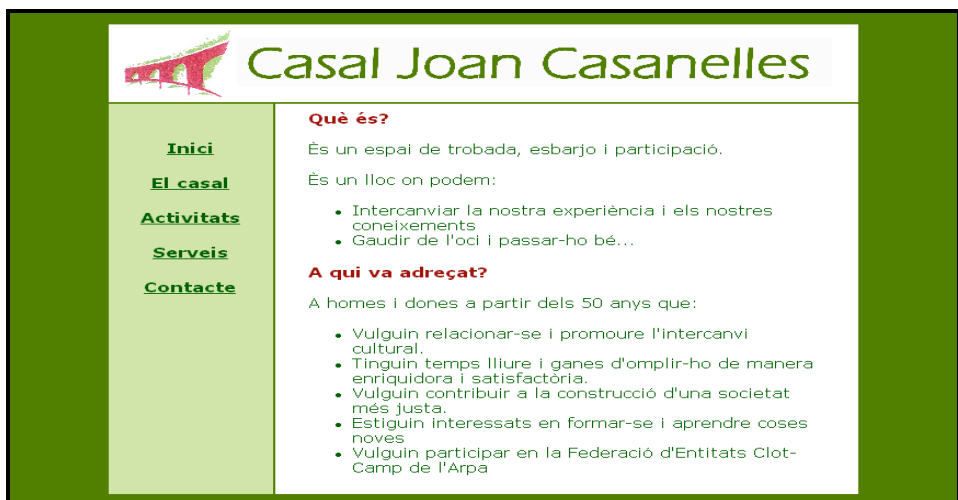
Figure 15: Final prototype for JC

e) Discussion

We consider the novelty of this paper in the evaluation of two techniques for improving web accessibility defined in guidelines promoted by WCAG 2.0 with older people. The evaluations have taken place in real scenarios and in two different settings.

Even though the results might not be representative of other contexts and users, the results have showed some of the problems that older people who are taking up the web experience going online and the efficacy of WCAG 2.0 to solve them. The results have uncovered that WCAG 2.0 do not consider carefully enough some of the needs of this type of older computer users. Considering the relevance of WCAG 2.0 in web accessibility and population ageing, these findings suggest that more research in this area is required.

The results have shown that 'click here to' links improve web accessibility when these links are embedded in paragraphs. Standard underlined links are easy for older people to recognize and click on when links are the main sections of web pages. The results have also shown that click-able pictures should resolve to full size rendering of those images rather than opening a new web page. These results might inform the design of web accessibility guidelines for older people in the WAI-AGE project.

The results have also revealed that older people prefer using the mouse to the keyboard so as to navigate online, despite the fact that they find it more difficult to use the mouse than the keyboard. Older people aspire to use the same technologies as other people, such as their grandchildren and adult children, use in their interactions with the web. This suggests that accessibility improvements based on technologies that can make older people feel different or in need of special assistance might face serious acceptance difficulties.

Let us end the paper by outlining our future research lines. We are going to analyze the level of WCAG compliance of Spanish websites aimed at older people and to identify whether the main

accessibility barriers suggested by the technical analysis correspond to those faced by older people, and how these obstacles can be overcome. We are also planning to elaborate on the efficacy of other techniques and guidelines defined in WCAG 2.0 with older people in several types of web interfaces, ranging from desktop to mobile ones.

f) Acknowledgements

g) References

[1]. Camacho, L. and Sayago, S. Design and evaluation of a simple web site WCAG complaint for older people. MSc in Computer Science, Universitat Pompeu Fabra, Barcelona (Spain), 2006

[2]. Krippendorff, K. Content Analysis. An Introduction to Its Methodology. SAGE, 1980.

[3]. Krug, S. Don't Make Me Think! A common sense approach to web usability. Prentice Hall, 2007

[4]. Paciello, M.G. Web accessibility for people with disabilities. CMP books, Kansas, 2000

[5]. Sayago, S. Some aspects of ICT accessibility and design methods with the young elderly. MPhil in Computer Science and Digital Communication. Universitat Pompeu Fabra, Barcelona, Spain, 2006.

[6]. WAI-AGE (IST 035015). http://www.w3.org/WAI/WAIAGE/.

[7]. Web Content Accessibility Guidelines (WCAG) 2.0. W3C Recommendation 11 December 2008. http://www.w3.org/TR/WCAG20/.

4. SOCIAL ASPECTS AND LIFE EXPERIENCE

This chapter is about the relevance of social circles and life experience when training older people to master ICT. This chapter presents two exploratory case studies published in:

[21]. Sayago, S., Santos, P., Arenas, M. and Gonzalez, M., 2008. Meeting some educational needs of elderly people in ICT: Two exploratory case studies. ACM Crossroads, 14.2.

Both case studies draw on an ethnographical study, which revealed that learning activities following traditional and most common educational methodologies are quite unfit for older people education in ICT. Much as they might have some experience with traditional learning, the length of their life experiences eclipses their school experience (if any). Older people have learned most of the things they know by talking to people rather than attending classes or reading books. It is also uncovered that social relationships established with adult children are very important. Older people wish to show their children that they are perfectly able to go online, contrary to popular beliefs. In addition to children, close friends play an important role, due to the socialisation of learning, which is a very important factor.

Both life experience and social learning guided the development of two novel prototypes for meeting their educational needs in ICT. Building upon two scenarios identified in the ethnographical study and a technical analysis of an online campus being used by the participants of this study, two prototypes based on Yahoo! Flickr and Blogs were designed by employing participatory design techniques. These prototypes were designed to be integrated into the online campus. Two focus groups with 10 older people were carried out in order to evaluate the prototypes. The participants valued the usefulness of the prototypes in terms of allowing them to show their projects and material to their grandchildren and children, as well as enabling them to work with close friends.

4.1 Meeting Educational Needs of the Elderly in ICT: Two Exploratory Case Studies

a) Introduction

While the advent of information technology in the form of PCs and the Internet has revolutionized the way people work, play, and interact, many elderly people are left behind [14]. They grew up without computers and therefore have more difficulty in perceiving the value and usefulness of ICT (information and communication technologies) in their daily activities than do young and middle-aged people. Luckily, there are many initiatives and research to educate and encourage the use of ICT among the elderly [6,7]. Even so, very little is known about the educational needs of elderly people in technology and the methods to meet them. In this report, we present two exploratory case studies that uncover some educational needs of elderly people in ICT based on their life experience, and explore the use of social Web technologies to satisfy them.

The results of this experience indicate that special consideration should be given to life experience and social relationships in elderly education in ICT. The reason is that the elderly have acquired a great amount of knowledge and experience during their lifetime, and these can be difficult to change or ignore as they continue to age.

This finding is bound to challenge traditional learning methodologies, which place more emphasis on the individual than on groups. The elderly have traditionally learned through human interaction rather than reading books or taking exams. This experience also shows that the social relationships established between the elderly and their social circles (namely, other adults, children, and grandchildren) play an important role in the motivations and perceptions of elderly people for learning to use ICT.

We employ digital literacy courses. These courses are likely to be most effective when ICT is used as the course material and educational media [21]. This approach will allow elderly students to

be fully immersed in an ICT environment. In light of the importance of life experience and social relationships, we designed and evaluated two prototype courses based on social Web technologies including Yahoo! Flickr [23] and blogs.

The work presented here has been carried out within the framework of the APADIS project [2], an R&D project funded by IMSERSO intended to design and develop an online virtual learning environment that meets the educational needs of elderly people in both online and traditional learning. APADIS seeks to enhance the current version of the ABE Campus [1] (adult basic education) by taking the needs, interests, and opinions of both instructors and students into account. The ABE Campus is currently being used in a broad array of courses for adult and senior education at Ágora in the School of Adult People La Verneda-St. Martí located in Barcelona, Spain [18].

The remainder of this report is organized as follows: In the first section, we present some educational needs of elderly people in ICT. In the second section, we describe two scenarios in which our prototypes satisfy them. Finally, we show our research conclusions and future work.

b) Some Educational Needs of Elderly People in ICT

To understand the educational needs of elderly people in ICT, we conducted an ethnographical study which surveyed older and middle-aged people who have been enrolled at the school for two years. This fieldwork was conducted in a bottom-up fashion in order to uncover aspects that hinder the elderly from learning about ICT. The ethnographical notes were analyzed using well-known qualitative techniques, such as content analysis [5,9]. The data is further supplemented by a comprehensive literature review on ICT accessibility and the elderly, which is carried out within the context of our ongoing research [17].

We start off by giving an overview of the courses organized by Ágora. Afterwards, we present some results of our ethnographical research.

b.1) Overview of the Courses in ICT Organized by Ágora

Ágora is a member of the Omnia Network, a project launched by the local government of Catalonia that is intended to introduce adult and elderly people to ICT. Ágora offers a wide range of courses in ICT that cater to the members of more than 1000 associations. During our research, we have been involved in several courses where the students (mostly elderly) are taught basic and advanced Web navigation, communicating via the Web, Web design, and document editing.

The course content and the media of delivery are usually overlapping. For example, the elderly learn about e-mail by using existing Web mail services. Moreover, most of the coursework involves group activities to encourage group learning. An example project is to create a Word document with images and textual descriptions of a country. These courses are very appealing and effective; in fact, afterward, some students advance to become instructors.

b.2) The Impact of Life Experience on Senior Education in ICT

Recent research has shown that one of the major differences between elderly and young students is that elderly people bring information and experience that their younger classmates do not have [3]. Consequently, there are obvious differences in motivations between the elderly and their younger counterparts. While young people are mainly interested in learning in order to find well-paid jobs, the elderly want to learn to improve their lives for self-actualization [7]. To design digital courses to help the elderly students, understanding this motivational gap is paramount.

According to our ongoing research, life experience has a considerable impact on several layers of senior education in ICT. The elderly population is generally characterized by their low level of education [7,13]. They were brought up in a traditional education system, and therefore may not realize the potential of ICT education in their lives. For instance, unlike elderly students, younger students tend to read the written material from the courses when they need to carry out a task or find information. Elderly people in this case would often ask their classmates, without resorting to the class

material. We thus believe that typical activities carried out in traditional learning methodologies are not natural for the elderly in ICT learning, whereas they are for younger students.

Historically, elderly people in Spain or in other countries such as the U.K. learned mostly by interacting with people rather than taking exams. Many can argue that elderly people do take exams in their primary or secondary school. However, the length of their life experience eclipses their school experience (if any). As a consequence, learning activities within most traditional and common methodologies are probably unfitting for senior education in ICT. For instance, when elderly students were asked about the possibility of taking exams in digital literacy courses, they reacted negatively. The following quote, taken from our ethnographical notes, illustrates this:

Exams will act as a deterrent for us to take these courses. All of us are more interested in learning how to use a computer in an atmosphere which fosters learning than in obtaining official certificates; indeed, we do not need them.

While there are elderly people with a certain level of experience or familiarity with ICT who tend to be more individual or independent than those without experience, this is not the rule. Most elderly people show a strong preference towards learning in a group setting. We have found that this is not only perceived as a natural way of socialization, but also as a natural way of learning. Working in groups enables them to discover new things (motivation) by sharing their knowledge with peers (socialization).

Another impact of life experience on seniors is the effect of positive and negative social relationships established between the elderly people and their social circles on the motivation and perception of usefulness of ICT. Even though social relationships play both positive and negative roles in aging, in studies into ICT and the older population they tend to play a more positive role [19]. For instance, grandchildren tend to be an encouraging element for the elderly to go online, as they relish being very close to them. Nevertheless, we have found that negative social relationships established between adult children and their parents turn out to be

an essential component to understanding some educational needs of elderly people in ICT in more detail.

We believe that elderly people fear using computers because their adult children forbid their parents from using computers in fear of them breaking. This is particularly important in light of the striking changes in family units in Spain, where young and middle-aged people tend to live longer with their old relatives than some years ago. Within this context, it is difficult to imagine an elderly person learning to use a computer freely at home. Learning in groups helps them overcome these fears.

We have found that when they gain knowledge in using computers, the elderly are eager to demonstrate their ability to use computers properly to their adult children. The elderly are also very keen on using the Web, which, as our ongoing research shows, is one of the most relevant indicators of digital literacy amongst the social circles of elderly people.

We have not identified this necessity amongst middle-aged people, who do not generally need to prove that they can use computers properly. It is worth noting that educational approaches based on group learning have also been proposed in studies with ethnic minorities [11,21].

c) Meeting Educational Needs of Elderly People in ICT

In this section, we describe the two prototypes that have been designed to both meet the educational needs of elderly people in ICT and be integrated into the current version of the ABE Campus. We start by outlining each of the two scenarios, which were identified during our ethnographical research, and then we discuss the design and development of the prototypes. Afterwards, we give an overview of the user-centered design process followed in the development of the prototypes along with technical details of their implementation.

c.1) Scenarios Where These Needs are Realized

As stated in [4], the defining property of a scenario is that it projects a concrete description of an activity that the user engages in when

performing a specific task, a description sufficiently detailed so that design implications can be inferred and reasoned about.

Scenario 1: Sharing and Browsing Pictures Online

A typical activity carried out by the participants in these digital courses is to download online pictures of the town where they were born or a country they would like to visit and use it in their projects, e.g., a Word document or an e-mail. While this is an individual activity, there is much interest in changing it into a social task by working with pictures downloaded by other participants and accessing them using the ABE Campus either at home or at school.

Scenario 2: Writing Reports Online with Other Participants

A typical activity carried out by the participants in these courses is to write documents about a place, e.g., city, town, national garden, they would like to visit. In this forum they socialize and learn from others; however, the current version of the ABE Campus does not allow online collaboration. We attempted to solve this need by e-mail, but our ethnographical study notes indicated that this is an awkward practice because the participants relish using the ABE Campus, which was designed to be used in the courses at the school.

c.2) Overview of the Design and Evaluation Process

To solve both scenarios, we selected two prototypes based on Flickr and blogs. Both prototypes were designed by taking a critical communicative approach [8]. This methodology aims to facilitate the end-users' participation in the research on egalitarian terms, promote creation of meaning through interactions, and focus on processes in which egalitarian dialogue and transformation of the context prevail by nurturing dialogic relations based on reflection, self-reflection (critical), and communication.

Requirements Gathering and Design Criteria

Within the framework of a user-centered design process [15], identifying the needs of the end-users by asking and observing them

allows us to get an in-depth insight into how they carry out their daily activities. The ethnographical research allowed us to acquire this knowledge.

In addition to the users' needs, we needed to understand and consider ABE Campus' technical details for better integration. From our technical analysis, two noteworthy aspects came to light:

- The ABE Campus has been developed using open source technologies such as PHP, JavaScript, and MySQL.

- The ABE Campus users are students, volunteers, and teachers. They might not be experts on computers.

Both the ethnographical research and the technical analysis of the Campus enabled us to identify a number of design criteria, which will be contemplated throughout the design and development of the prototypes. Two of the most important criteria are listed below:

In order to satisfy the requirement of integration, not only must the prototypes use similar technologies such as PHP and MySQL, but also look similar to ABE Campus' interface, especially because the school's teachers, volunteers, and students are familiar with it. The main objective of this project is to improve the current version of the Campus, not develop a new solution from scratch. With respect to the students, the prototypes must cater to their educational and special needs with the latter being derived from age-related changes in functional abilities [10]. With regard to the teachers and volunteers, the prototypes must be easy to use, install, and maintain on a daily basis.

Iterative and Participatory Design

With the aim of taking the needs and interests of elderly people into account and in compliance with the critical communication methodology defined by the CREA-UB, the APADIS project organizes monthly commissions with project members and elderly students in order to guarantee that their needs and interests are considered throughout the project in a communicative and inclusive manner. These meetings are often organized at La Verneda, the main facility where the prototypes will be used during the project.

76

In order to guarantee a certain level of validity, the minutes are read aloud before the end of each meeting.

The prototypes were designed in an iterative and participatory way. In the early stages of design, major ideas behind each prototype were presented to a group of 10 end-users. This presentation mainly consisted of associating prototypes' functionalities with the educational needs of the elderly, such as browsing pictures online and working collaboratively on common projects online. Overall, the minutes of this meeting indicated that all participants showed significant interest in the prototypes. Nevertheless, more stable versions of the prototypes were required in order for the participants to ascertain whether these technologies truly lived up to their expectations. Finally, after the stable prototypes were released, there was a follow-up meeting, in which the prototypes were formally presented. The participants were encouraged to use them and discuss the tools' worst and best aspects. In general the prototypes were on the right track, and the participants looked forward to using them.

Usability Evaluation

In order to gauge the usability of the early prototypes, we conducted two focus groups. Naturally the interviews were conducted at La Verneda, where the elderly students had previous exposure to ABE Campus software. Using our prior experience in running focus groups with the elderly [16], we set up two groups totaling 10 elderly people who were enrolled in courses at La Verneda. The overall agenda is outlined as follows:

● A brief overview of the prototypes was given prior to each usability session.

● A number of representative tasks were conducted using the prototypes by the evaluation monitor and the participants were encouraged to give their feedback.

● The participants were asked to interact with the prototypes by thinking aloud in a group setting. This activity fosters discussion and provides the most qualitative feedback.

● At the end of each session, a summary of the problems that were identified was read aloud, and the participants were asked to agree (or disagree) to guarantee validity.

Overall, the results are encouraging. All of the participants regarded the prototypes as valuable solutions to meet their educational needs. Some of the comments gathered during the sessions included, "Can my grandchildren see the pictures we use in the courses? That's great!", "This is the kind of thing that we need in the courses," and "I have immediate feedback and I can write a document with another participant, either at home or school."

The major usability pitfalls were related to the terminology used on the prototypes' interfaces and lack of extra functionalities. The participants felt that some words were difficult to understand, even if the terms are common in software interfaces. For instance, the standard label examine, which is displayed on open file dialogs, was associated with medical checkups rather than searching for a file.

More importantly, some students felt that the prototypes lack some common functionalities such as providing options to delete or update files online. This hinders some students from using the prototypes efficiently.

c.3) Technical Description of the Two Prototypes

Sharing and Browsing Photos and Pictures

There are numerous systems that allow us to share photos on the Web, such as ImageEvent and AOL You've Got Pictures. We selected Yahoo! Flickr, an online photo sharing system, because it meets the educational needs of elderly students in ICT, and it integrates well into ABE Campus. This Web 2.0 service takes advantage of social tagging [23]. It allows users to organize and share photos using commonly defined tags. Flickr also has a large number of open source APIs, suitable for integration into the current version of ABE Campus. Finally, many other initiatives and projects use Flickr [23]. This indicates that this service is well-supported, which is a noteworthy aspect in the development of open source systems.

The main functionality of this prototype is to allow students to upload their course pictures and images to Flickr using the ABE Campus. The students should also be able to browse their pictures using Flickr. This way, one can store and browse previously downloaded photos to share with friends and relatives (Figure 16).

Figure 16: Prototype based on Yahoo! Flickr

Taking the requirement of integration into account, the prototype has been developed by using both the Flickr! PHP library [25] and a simple MySQL database. The PHP library allows us to establish a connection with the Flickr server and upload the pictures selected by the users to an account in Flickr. The database acts as an internal repository of pictures, which are organized into several categories corresponding to the school's courses.

To better integrate the prototype with the ABE Campus, its user interface must be consistent with the ABE Campus. We have sought to meet this requirement by using the same online form that the students use in the courses to upload their reports to the campus. We added an option to this form to upload photos to Flickr. As shown in Figure 1, the end-users can select whether to upload the picture to Flickr or not. All of the technical details are invisible to them, which is a desirable trait for a system used by nonexperts.

Apart from uploading pictures to Flickr, the prototype can store photos in the ABE Campus's database. This functionality was implemented with the aim of allowing instructors to reuse the

photos in other educational activities, such as open events. Of course, the students have privacy control over their own pictures.

To share photos internally, we developed a simple virtual gallery (see Figures 17 and 18). This gallery allows students and teachers to browse their pictures using the ABE Campus (Figure 17). The gallery is written in PHP and MySQL to satisfy the integration requirement. With respect to the user interface, we took special needs of elderly students into consideration by carefully selecting the language and terminology such that they are much easier to understand. Our design adheres to guidelines for Web accessibility for the elderly [12]. The user interface has one screen per functionality, displaying information that is necessary to conduct a specific task.

**Figure 17: Simple virtual gallery (1)**
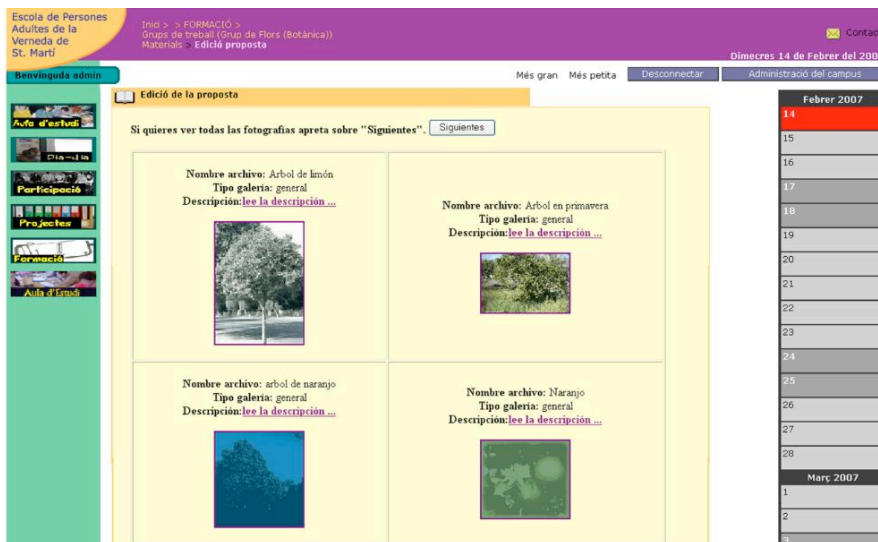
Figure 18: Simple virtual gallery (2)

Writing Documents Online with Other Participants

Wikis and blogs allow us to write online documents collaboratively. We did not believe that a wiki could meet our requirements because of the difficulty of installation and maintenance by nonexperts. Blogs are more attractive because there are existing versions maintained by elderly adults in SeniorNet [27]. Furthermore, there are SeniorNet organizations that use blogs as the platform to create a significant component of their home pages, e.g., SeniorNet Dallas [24]. We decided to use blogs in the APADIS project to meet the scenario requirements.

Our analysis indicates that there are two types of blogs. One type can be installed onto a local server, e.g., WordPress [26] and Simple PHP Blog [28]. This type of blog allows us to control the presentation and content. The drawback is that a server becomes necessary. The other type of blogs are hosted at external hosts. These eliminate the need to install the application on a local server, but our control becomes very limited. After carefully weighing both approaches, we selected the first type, inasmuch as teachers and staff of an adult school need to take as much control as possible over the material and information available at the school's Web site.

Among the blogs that are installable to a local server, we chose WordPress because it is written in PHP and MySQL for easier integration with the ABE Campus. Additionally, we had prior experience with WordPress from a European Project on eLearning [20]. We found that (1) its installation process does not involve many technical aspects, (2) the administration user interface renders almost all the technical details invisible, and (3) it is very simple to use for nonexpert users. WordPress has some advantages over other similar blogs, such as Simple PHP Blog and Blog LiveCMS:

● The WordPress user interface is completely customizable.

● WordPress is widely used by large companies in Spain, such as Telefónica (http://www.creamoselfuturo.com).

The blog, as shown in Figure 19, is divided into several sections that correspond to the courses and activities in adult and basic education at Ágora. The list of courses is displayed on the right column of the figure. This blog allows students to create reports online while remaining in a group setting. The students receive immediate feedback because all updates such as edits and insertions are reflected almost instantaneously. They can immediately see comments on their posts or reports. Furthermore, all reports can be accessed by using a Web browser, which allows students to show their reports to their friends and relatives using the Web.

Figure 19: Prototpye for collaborating editing of documents

d) Conclusions and future work

With respect to the educational needs of elderly people in ICT, the exploratory case studies indicate that special consideration should be given to life experience. Elderly people draw firmly on the on the knowledge and experience gained during their lifetime, and it is very difficult to either change or eliminate later in life. The results of our ongoing work strongly recommend learning from their past to design effective learning solutions for the elderly. A striking implication of this suggestion, which warrants much more research, is that traditional learning methodologies are bound to not fit in senior education in ICT because they do not consider details in life experience. For instance, the elderly have traditionally learned by communicating with other people rather than reading books or sitting for exams. To be successful, one has to consider this reality when designing learning materials and methodologies. In this report, the impact has been on using social Web technologies, which foster group activities and strengthen specific social relationships.

In addition to some educational needs of the elderly in ICT, this paper has uncovered some requirements for designing accessible user interfaces. Although aspects such as age-related changes in

vision and cognition play an important role in designing for the elderly, we have found that using easyto-understand language should not be overlooked. This finding is also tied to the importance of life experience, since the elderly expect to communicate with an application by using familiar language and not computer jargon. Apart from this, technologies for supporting the special educational needs of the elderly in ICT should be designed by considering that the instructors or learning providers who will use them are not necessarily experts in using computers.

The results presented in this paper should be understood within the context that senior education in ICT is a very fertile research area and there are many unanswered questions. The educational value of the prototypes described in this report has not been evaluated in detail. The first series of usability and technical evaluations initially confirm that the prototypes meet their educational needs. Nevertheless, the prototypes should be evaluated in a follow-up study in order to assess their educational values and confirm the hypothesis that traditional learning methodologies are not suitable for senior education in ICT. In addition to this, the elderly are a very heterogeneous group and much more user input is needed to draw significant conclusions as to the impact of life experience on the educational needs of the elderly in ICT.

In the future, we expect to overcome these limitations. We aim to shed some light on the blurred area of senior education in ICT by using an inclusive approach and multidisciplinary combination of research methods in order to form a better understanding of the educational needs and interests of the elderly in traditional and online learning.

e) Acknowledgments

f) References

[1]. ABE Campus. Virtual adult basic education communities in Europe (110694-CP-1-2003-1-MINERVA-M).

[2]. APADIS - Generación de un entorno virtual de aprendizaje accessible para Personas Mayores con o sin discapacidades. El aprendizaje abierto y a distancia en la educación formal y del tiempo libre de las Personas Mayores. Funded by IMSERSO and the Spanish Ministry of Work and Social Affairs. http://www.seg-social.es/imserso/investigacion/inv_imasdconv2006.html, 2006-2007.

[3]. Baringer, D.K., Et al. Instructional communication and older adults. in Nussbaum, J.F. and Coupland, J. eds. Handbook of communication and aging research, Lawrence Erlbaum Associates, 2004, pp: 543-563.

[4]. Carroll, J.M. (ed.), Scenario-based design. Envisioning work and technology in system development. John Wiley & Sons, 1995.

[5]. Denzin, N.K. and Lincoln, Y. (eds.). The SAGE handbook of qualitative research. 3rd edition. SAGE Publications, 2005.

[6]. Gilligan, R. Initiatives encouraging e-learning among older Europeans, Institution for the Study of Social Change, 2003.

[7]. Glendenning, F. Education for older adults: lifelong learning, empowerment, and social change. In Nussbaum, J.F. and Coupland, J. eds. Handbook of Communication and Aging Research. Second edition, Lawrence Erlbaum Associates, 2004, pp: 523-543.

[8]. Gómez, J., Latorre, Et al, R. Metodología comunicativa crítica. El Roure, Barcelona, 2006.

[9]. Gubrium, J.F. and Holstein, J.A. (eds.). Handbook of interview research. Context & Method. SAGE Publications, 2001.

[10]. Hawthorn, D. Possible implications of aging for interface designers. Interacting with Computers, 2000, 12, pp: 507-528.

[11]. Henning, E. and Westhuizen, V.d. Crossing the digital divide safely and trustingly: how ecologies of learning scaffold the journey. Computers & Education, 2004, 42, pp: 333-352.

[12]. Kurniawan, S.H. and Zaphiris, P., Designing for individuals with memory and cognitive disabilities: research-derived Web design guidelines for older people. in Proceedings of the 7th international ACM SIGACCESS Conference on Computers and Accessibility Assets '05, (Baltimore, Maryland, 2005), pp: 129-135.

[13]. Larra, R.M.d. Los mayores en la sociedad de la información: situación actual y retos de futuro, Fundación AUNA, Madrid, 2004.

[14]. Melenhorst, A.-S. and Bouwhuis, D.G. When do older adults consider the internet? An exploratory study of benefit perception. Gerontechjournal, 2004, 3 (2), pp: 89-101.

[15]. Nielsen, J. Usability engineering. Academic Press, Boston, 1993.

[16]. Sayago, S. and Blat, J., Conducting thinking-aloud tests and focus groups with the young elderly. in Workshop on HCI, the Web and the Older Population, at HCI 2006, (Queen Mary University, London, 2006), pp: 23-25.

[17]. Sayago, S. Some aspects of ICT accessibility and design methods with the young elderly. Master Thesis in Computer Science and Digital Communication., Universitat Pompeu Fabra, Barcelona, Spain, 2006, 148.

[18]. School of Adult People La Verneda-St. Martí. http://www.edaverneda.org. Retrieved in 2007.

[19]. Selwyn, N. The information aged: A qualitative study of older adults' use of information and communications technology. Journal of Aging Studies, 2004, 18, pp: 369-384.

[20]. TENCompetence, Building the european network for lifelong competence development, http://www.tencompetence.org.

[21]. Trentin, G. E-learning and the third age. Journal of Computer Assisted Learning, 2004, 20, pp: 21-30.

[22]. Webb, S. Can ICT reduce social exclusion? The case of an adults' English language learning programme. British Educational Research Journal, 2006, 32, pp: 481-507.

[23]. Yahoo! Flickr. http://www.flickr.com. Retrieved in 2007.

[24]. http://www.seniornetdallas.blogspot.com. Retrieved in 2007.

[25]. http://phpflickr.com/. Retrieved in 2007.

[26]. http://wordpress.org/. Retrieved in 2007.

[27]. http://www.seniornet.org. Retrieved in 2007.

[28]. http://www.simplephpblog.com/. Retrieved in 2007.

5. ETHNOGRAPHY, USE AND INTERACTION

This chapter is about the severity of interaction barriers with ICT in the real life context outside the lab. This chapter also explores the everyday use of and interactions with e-mail. The Section 5.1 and 5.2, contain respectively the following papers:

[14]. Sayago, S and Blat, J., 2009. About the relevance of accessibility barriers in the everyday interactions of older people with the web. International Cross-disciplinary Conference on Web Accessibility (W4A-ACM), pp: 104-113, April 20-21, Madrid (Spain). **Best Paper Award**. ACM ISBN: 978-1-605558-561-1

[16]. Sayago, S. and Blat, J., 2009. Telling the story of older people e-mailing. International Journal of Human-Computer Studies. Revision sent after first provisional acceptance

Section 5.1 reveals and explains the relative relevance of interaction barriers in everyday interactions with ICT. This study of barriers draws on the ethnographical study already mentioned. Analysis of observations, formal and informal conversations and artifacts such as older people's notes revealed that difficulties remembering steps, using the mouse and understanding terminology are much more important than those due to perceiving visual information, using the keyboard and understanding icons. This prioritization of barriers is accounted for by the independence and inclusivity goals of older people and consistency in an appropriate language of user interfaces. It is worth mentioning that this paper won a Best Paper Award in an ACM conference on Web Accessibility whose topic was older people.

Section 5.2 draws on the same ethnographical study as the one cited before. However, the focus of this section is on telling the story of older people e-mailing. Previous studies focused on developing e-mail systems for older people without exploring how they e-mail in their lives. The paper presented in this section aims to fill this gap. This is done by unveiling (i) different communication patterns established with different social circles; (ii) the relationship between e-mail systems and other ordinary technologies; (iii) the socialisation of e-mailing, which is barely carried out individually;

(iv) the effects of previous experience with paper mail in making electronic mail their own and (v) the interactive experiences created in e-mailing, such as the joy of receiving an e-mail from grandchildren. This story is claimed to enrich considerably current research. This section ends up with a collection of pictures taken during the length of the study. These pictures aim to represent key findings of the story of older people e-emailing.

5.1 About the relevance of accessibility barriers in the everyday interactions of older people with the web

This paper reports key findings of a 3-year ethnographical study of the everyday interactions of older people with the web. The data consisted of in-situ observations and conversations with 388 older people while using myriads of web and computer technologies daily. The results revealed that the accessibility barriers that had a more negative effect on the daily interactions of older people with the web were due to their difficulties in remembering steps, understanding web and computer jargon and using the mouse, despite their willingness to use it. These obstacles were much more important than those caused by their difficulties perceiving visual information, understanding icons and using the keyboard. The prioritization of barriers was explained by two key aspects in ageing with new technologies, independency and inclusiveness, and a desired condition of web (user) interfaces, consistency in terminology. These results suggest that these three aspects should be considered carefully in enhancing web accessibility for older people, as well as allowing us to grasp older people's everyday web accessibility barriers. The paper discusses possible ways of making use of these findings to make the web more accessible to older people.

a) Introduction

Both population ageing and the relevance of the web to current society have created a need for web accessibility for older people, who encounter numerous and varied accessibility barriers when going online. Very little is known about the relevance of these obstacles in their everyday interactions with the web, despite the

fact that understanding the daily interactions of people with interactive technologies as they occur in real-life settings is essential for designing better interactions [6, 31, 38].

This paper reports key findings of a 3-year ethnographical study of the everyday interactions of older people with the web. Namely, drawing on the well known need to prioritize problems in user interface design and evaluation, the heterogeneity of barriers faced by older people and the effect of previous experience and education in HCI research with older people [48], this paper addresses two important questions:

(1) Which are the most and least relevant accessibility barriers for older people to interact with the web in their daily lives and why?

(2) How does vary the relevance of web accessibility barriers according to older people's previous experience with the web and educational levels?

The ethnographical data consisted of first-hand observations and conversations with 388 older people while using a myriad of web and computer technologies on a daily basis. Older people are defined herein as individuals over 65 years of age that experience normal age-related changes in major live functions. The data was analyzed by using Ground Theory methods [21].

The results revealed that the prioritization of accessibility barriers is largely independent of technology, experience with the web and educational levels. Difficulties in remembering task-related steps, understanding technical words and using the mouse, despite their willingness to use it, were the accessibility barriers that hindered the daily interactions of older people with the web the most. These obstacles were much more relevant those caused by older people's difficulties perceiving visual information, understanding icons and using the keyboard, which could be thought of as being noteworthy web accessibility barriers as well. This (lack of) relevance of barriers is accounted for by two desired conditions in ageing (within the context of the web), independency and inclusiveness, and one element of web (user) design, consistency in terminology. Independency is the ability of older people to use the web on their own. Inclusiveness is the aspiration of older people to interact with

the web by using ordinary technologies so that they can not give the impression that they are different or in need of special assistance.

Overall, it appears from this study that inclusion, independency, and consistency in terminology ought to be considered more carefully in order to make the web more accessible to older people. The results also suggest that these three aspects can help us apprehend the accessibility barriers that older people encounter in their daily interactions with the web.

Section b) argues that exploring the relevance of web accessibility barriers in the daily interactions of older people with the web is worthwhile. Section c) describes the ethnographical study. Section d) presents the results. Section e) shows some implications based on the results for making the web more accessible for older people. Section f) discusses the results. Finally, section g) shows some conclusions and outlines future research perspectives.

b) Related work

Central to web accessibility research with older people has been to compensate for the numerous barriers that they encounter in going online. These barriers are primarily due to age-related changes in functional abilities (vision, hearing, cognition and mobility) and a general lack of experience with the web. Much research has been carried out by using interviews and usability tests, conducted in either laboratory settings or controlled situations. Let us illustrate this focus on major live functions and research approach by reviewing guidelines, software and hardware developments and studies into the use of the web by older people.

Common to the large number of web guidelines for older people are recommendations for coping with age-related changes in vision, hearing, mobility and cognition on web design (e.g. [1, 16, 26, 33, 49]).

E-mail systems, web portals, systems for web search and navigation, web pages and software personalization and input devices are also geared towards compensating for age-related changes in functional abilities and previous experience with the web. Simpler screens and reduced functionalities were key aspects

in the design of email systems for older people [3, 14, 24]. Usability tests conducted in controlled environments and interviews were carried out in the development of these systems. In designing a portal for older users [35], the design principles focused on age-related changes in vision and memory, and on a general lack of experience of older people with web concepts such as technical jargon and when to double-click. This portal was developed by using focus groups and usability tests in controlled environments. In the development of a system for web search and navigation [13], published guidelines on visually accessible design for older people were used to inform the visual design and layout. Constantly available instructions written in a non-technical language were also designed to allow older people to use the system without relying so much on learning and retaining new and unfamiliar concepts. An important component in the development of this system was an iterative evaluation of prototypes, carried out by means of usability tests in controlled situations. In examining different ways of personalizing web page presentation to alleviate functional impairments (vision, motor, cognitive and hearing impairments) [29], it transpired that the system that required the least efforts to interact with it while preserving the original layout of web pages was the most appropriate for older adults. A usability test was conducted in a community centre under a well-controlled situation. The effect of age-related changes in functional abilities on reading from screen and using the mouse, amongst others, play a pivotal role in software personalization to meet the needs of older people [23]. Studies into input devices for older people also highlight the relevance of age-related changes in manual dexterity in the precision and the interaction of older people with input devices for web browsing [27].

Studies into the use of the web by older people are also centered on age-related changes in functional abilities and a general lack of experience with the web as well. In [47] it was found that small font sizes, confusing advertisements and the standard mouse were accessibility barriers for nuns to go online. This study was based on a survey measuring life satisfaction and attitudes towards computer use. The results of [22] indicated that elderly users were slower than college-age users; they also made fewer screen inputs, visited fewer pages, and were less likely to return to a previously visited page while completing a task (regardless of the site type). Nonetheless,

the elderly were more accurate than the young. Small font size and animated graphics were identified by both groups of participants as being distracting. [20] aimed to highlight the major hurdles disabled and/or older users encounter in Web portals. Scrolling, opening new windows in the browser, limiting the amount of information on a web page and the small size of buttons and the short distance between navigation buttons were significant accessibility barriers. Questionnaires, logfiles and usability tests in controlled situations were used. In [4] a search user interface for elderly people was proposed building upon a series of interviews and controlled experiments, conducted in an association. Problems with terminology, using the mouse and remembering the structure of the web were reported.

It is also worth mentioning that the predominance of age-related changes in major live functions is also noticeable out of web accessibility. For instance, [25] claims that the majority of assistive technologies for older people have been primarily designed by considering age-related declines in functional abilities, despite the fact that other factors, such as social and environmental ones, are also worthy of attention. In adapting design methods such as focus groups [6] and individual interviews [18] to the special needs of older people, the requirement of adaptation stems from age-related changes in sight, hearing, cognition and mobility. In new technologies such as DTV (Digital TV) [39], the effect of age-related changes in functional abilities on the interaction between older people with TV controls and software interface plays a pivotal role in making these technologies more accessible to them.

Despite the efforts undertaken, which accessibility barriers identified by previous studies are the most or least relevant for the everyday interactions of older people with the web? In other words, which barriers do hinder their interactions most and why? Today's research is insufficient to answer this question. First, social scientists have long recognized that what people say and what they do can vary significantly, making reliance on interview-based methods insufficient to the task of understanding what people actually do day to day [6]. Second, it is well-known that everyday settings are composed of many factors that affect how people interact and make use of technologies, which are difficult to simulate in controlled environments used in usability testing.

Why do we need to explore web accessibility barriers in the wild? There is growing awareness in academy, industry and corporate

settings that understanding the everyday interactions of people with technologies as they occur in real-life settings is a key ingredient in designing more accessible, useful and engaging technologies [6, 38]. This turn to "real" interactions is mainly motivated by the fact that Information and Communication Technologies (ICT) are no longer used by professionals in engineering environments for productivity purposes. Instead, they are used by people in naturally occurring settings for carrying out many different activities. Older people have experienced the web during a small part of their life, and not the most prone to learning and using it; they also differ considerably from the standard user in HCI research [12] and do not use the web (or interactive technologies, in general) for productivity purposes [46]. These aspects call for a deeper understanding of their everyday interactions with the web.

This paper has adopted an ethnographical approach in order to fill this gap, focusing on the relative relevance of web accessibility barriers. HCI has looked to ethnography so as to apprehend the complexity of real-world activities that people carry out with technologies [6]. Ethnographical methods provide a set of instruments with which one can study ICT "in the wild" in no other ways possible [15]. Ethnographical research has also been subjected to critiques, such as the veracity of ethnographical accounts [6, 31]. Even so, these shortcomings have not diminished the value of ethnography in furthering our knowledge about how people interact with ICT in their lives and, in so doing, informing the design of better interactions [6, 31, 38]. Nonetheless, no ethnographical studies into the barriers that older people face in their daily interactions with the web have been published in leading HCI journals and conferences as yet[27].

---

[27] Interacting with Computers; International Journal of Human-Computer Studies; Universal Access to the Information Society; ACM Transactions of Human-Computer Interaction; ACM Transactions of Accessible Computing; HCI – first issue – 2008; CHI ACM Proceedings, W4ALL, first conference – 2008. Keywords: ethnography, fieldwork, older people, older adults, elderly; web accessibility

c) Description of the study

c.1) Context

The study was carried out in Àgora from 2005 to 2008. Àgora is an association within La Verneda-St.Marti adult centre (Barcelona, Spain) with more than 20 years of live. Àgora has a strong commitment to the integration of sectors that are alienated from current Catalan society[28] into the active fabric of it. Many courses in a wide array of subjects, ranging from languages to cooking, are offered on a daily basis. These courses are free of charge. Between 1000 and 1500 people (generally referred as 'participants') enroll on courses monthly.

Mastering ICT is regarded by Àgora and participants as an essential element for inclusion into society. Àgora offers numerous courses in computing, as well as daily Internet access and workshops. Most of these activities are aimed at older people, who are particularly disadvantaged at ICT. Older people decide what technologies they want to (learn to) use in courses and workshops. Their decision is grounded in the use they want to make of these technologies in their daily lives rather than being imposed by pre-established syllabuses.

Participation is also within pedagogy, through dialogic learning [19][29]. Agora blurs the traditional division between teachers and learners. It is common to see how older people who started to take courses with little acquaintance with ICT have now a command of them and are the tutors of peers that are starting to take up ICT.

c.2) Participants and ethnographical approach

We aimed to develop a first-hand view of the accessibility barriers that older people encounter in their daily interactions with the web. To this end, we adopted an ethnographical approach inspired by

---

[28] Barcelona has been experiencing a wave of immigration with people fleeing from the north of Africa, the east of Europe and South America. These people have difficulties in their integration into society, mainly due to language barriers

[29] Agora has been operating in this way for more than 20 years and awarded by the local government of Barcelona and Catalonia for their contribution to Catalan society. http://www.edaverneda.org

traditional cultural anthropology [11] – ethnographies typically consists of a long period of immersion[30] into people's everyday lives, combining observation with participation. Our observations and conversations took place initially in courses, which, encouraged by the participatory philosophy discussed earlier, provided us with extensive material for real use of the web, very far from more artificial training settings.

388 older Spanish people participated in this study. They ranged in age from 65 to 80 years old. They hailed from Catalonia, the South and North of Spain. All of them lived in Barcelona and towns nearby. The participants experienced normal age-related changes in functional abilities, which were caused by the normal process of ageing. These minor impairments did not affect their ability to carry out ADL (Activities of Daily Living, such as bathing) and IADL (Instrumental Activities of Daily Living, such as banking or shopping) on their own. They acquired the abilities to use the web for their purposes during the length of this study. Their main motives behind taking up the web were: (i) not to lag behind in society, (ii) to remain closer to their dearest and nearest, and friends, and (iii) to enjoy the opportunity of learning that they did not have in their childhood.

While the participants are not representative of the current older population in some ways, older Spanish people have scant digital literacy competences [30], we believe they show the real use "older adults technology pioneers" are making of the web, and this is probably the best approximation we can have to ethnography when introducing innovation. Nevertheless, in other ways, participants were quite representative of ordinary people living in a developed country, as we describe next.

The participants had different educational competencies. 350 had low levels of education. They got degrees in primary school (attended between the ages of 6 and 12) or had basic literacy skills (i.e. being able to read and write). The rest of the participants (38) had higher educational levels. They got secondary school degrees

---

[30] It has become relatively standard in ethnographic inquiries to think of a minimum of a year of fieldwork as necessary to gain sufficient insight [11]

(attended between the ages of 12 and 16) or had specific certificates related to their previous jobs.

Those with low education also had scant digital literacy skills. Although they might have used some computer-related technologies in their jobs, such as calculators and cash registers, they had never used a computer or accessed to the web before in their lives. By contrast, participants with higher educational levels were familiar with basic web concepts, such as when to click and windows management. They had used some computer-related technologies in their jobs, albeit differing considerably from those they used in their everyday life - working tools were specialized for the activities they did in their jobs.

This profile was elaborated during the length of our fieldwork by conversing with the participants and some members of Àgora. We also had access to Àgora's records, in which the profile of the people attending the courses and activities organized were documented.

c.3) Ethnographical data and methods

The ethnographical data consists of in-situ observations and conversations with 388 older people in courses, workshops and meetings[31]. They were observed frequently (2 to 3 times, 2 to 4 hours each time, weekly) while using a wide range of technologies, depicted in Table 1. We used traditional paper and pencil to record participant's in-situ comments. Other methods such as video cameras and tape recorders were found to be very intrusive, in addition to being difficult to use in Àgora[32]. Two well-known types

---

[31] Meeting are organized by Àgora monthly in order to discuss the positive and negative aspects of the courses and activities carried out in the association, as well as being an opportunity to discuss aspects of the use of the web (and other ICT) in which participants have a special interest.

[32] Participants were used to seeing people taking notes with traditional technologies, viz. paper and pencil. They took their notes using these technologies, so this s was a natural practice in courses, meeting and workshops. However, participants were not used to seeing people taking notes by using laptops. They were also not used to being recorded while going online or using computers. Furthermore, Àgora did not allow video cameras in computer classes on the grounds that these technologies made people that are alienated from

of observations in ethnography were used, participant-observation and observation-participant [7, 39]. Part of this fieldwork took place in courses and workshops coordinated by one of us (212 participants: all courses except those in first row on Table 1, plus workshops). Another important part of our fieldwork was realized in courses, meetings and workshops where the authors attended as observers (176 participants: public meetings plus three courses in first row on Table 4). Table 4 describes the ethnographical implementation.

Activity	Technologies	Users	Duration
Course: Gardens	Yahoo! mail, Hotmail, Google, MS Word and PowerPoint	18	1 course. 6 months. 2-hour session every week.
Course: Towns in the World	Idem	18	1 course. 6 months. 2-hour session every week.
Course: Internet	Yahoo! mail, Hotmail, Google, Yahoo!, MS Word and PowerPoint, Websites (transport, health, TV)	36	2 courses. 1 month each course. 2-hour session every week.
Public meetings	Technologies used in the courses	40	2 meetings. Between 2 and 3 hours
Course: Online communication	Yahoo! mail, Hotmail, Chat, Blogs, Wikis, Forums, Google, Yahoo!	76	4 courses, which lasted 3 months. 2-hour session every week.
Workshops	Yahoo! mail, Hotmail, multimedia content edition , finding online information (directories, search engines), websites (transport, health, towns, news, TV)	18	3 workshops. 2-hour session every workshop
Public meetings	Blogs, Yahoo! Flickr, Yahoo! mail, Hotmail, wikis, websites	24	2 meetings. 2-hour session every workshop
Course: Advanced aspects of the web and computers	MS Word, PowerPoint and Excel, Yahoo! mail, Hotmail, Google, Yahoo!, Yahoo! Flickr, Google	76	Courses lasted 3 months. 4 courses organized. 2-

society feel very uncomfortable, as well as providing an unnatural environment for (learning to) using ICT.

	Earth, Websites (flights booking; routes; medical assistance)		hour session every week
Course: Online resources	File management, Windows management, Google, Yahoo!, Blogs, Yahoo! Mail, Hotmail, websites (transport, TV, health, traveling)	18	Course lasted 6 month. 1 course organised. 2-hour session every week.
Workshops	Blogs, Yahoo! Flickr, Yahoo! mail, Hotmail, wikis, websites	24	2 workshops. 2-hour session
Public meetings	MS Word, PowerPoint and Excel, Yahoo! mail, Hotmail, Google, Yahoo!, Yahoo! Flickr, Google Earth, Blogs, File and Windows management, websites	40	3 meetings. 2 hour-session

Table 4: Ethnographical implementation

A small number of participants (20, with previous experience with the web) were taking several courses at the same time and often involved in other activities organized in Àgora. The rest of the participants were more intermittent, mainly because of personal responsibilities – such as looking after their grandchildren or ill relatives - or due to health conditions. For instance, they took a course at the beginning of a year. When this course was over, they could not take another one until later in the year. In the meantime, they went to Àgora weekly to go online out of courses or to participate in monthly meetings and/or workshops.

All this ethnographical data was analyzed by using open, axial and selective coding and the constant comparison technique of the Grounded Theory approach for qualitative analysis [21]. We analyzed the data while we were gathering it (we decided to do it every 3 months) so that we could identify emerging issues [8]. The analysis initially involved one of the authors reading the entire field notes to gain an overall sense of the data. All the data was then read again and open-coded to produce an initial code list. This was done until, in the opinion of the two authors of this paper, analysis had reached theoretical saturation with the amount of information gathered so far. Most of the codes were adapted from the language of the participants, rather than drawing solely on our review of

literature. This reflected our attempt to tell the story of older people from their point of view, without theoretical preconceptions as to what will be found - which is the hallmark of ethnography. At the same time, axial coding was carried out to establish relationships between categories identified in open coding. From this basis, the data was then selectively coded in terms of core and subcategories categories identified with the initial and axial list of codes. This analysis was complemented by interaction analysis [38], which mainly consisted of analyzing participants' notes and interactions between them while going online day-to-day.

This analysis allowed us to identify and ground our research in the prioritization of accessibility barriers: difficulties remembering steps, understanding web and computer jargon and using the mouse are more relevant than difficulties perceiving visual information, understanding icons and using the keyboard, as well as elaborating the explanatory framework that accounts for this relative relevance of barriers: independency, inclusiveness and consistency.

The ethnographical data also consisted of 20 in-depth interviews, 8 focus groups and 5 semi-structured interviews with middle-aged technology instructors running computing courses in Àgora. Table 5 describes these interviews. A common theme was the accessibility barriers faced by older adults in their everyday interactions with the web[33].

Interview	Topics discussed
In-depth interviews	Interaction with email systems, difficulties and usage. The role of social relationships, relatives and friends, in emailing
Semi-structured interviews	The type of older people going to Àgora. The most and least important accessibility barriers faced in going online. The role of social relationships in training older people and in their interaction with new technologies
Focus groups	The most and least important accessibility barriers faced in web and computer technologies. The relevance of relatives and friends in their interactions

Table 5: Ethnographical interviews

---

[33] Other topics were discussed, such as the use of email and the role of social and intergenerational relationships in their everyday interactions. These topics have been analyzed in ongoing publications of the authors.

All these interviews were conducted in Àgora. We first agreed with the participants on a time and date to carry out the interview. We took notes by using paper and pencil in each interview, which lasted 1 hour. Group-based interviews lasted 2 hours. We then did the transcription of the interviews in our offices. Once the transcription was done, we fixed a second meeting with the participants. We read aloud the transcription and asked them to either agree or disagree on it, as well as adding more information if appropriate. The interviews were conducted as the research progressed and analyzed by using the methods (and categories) described before.

d) Findings

The findings are grouped into three sections. We first address input devices, comparing difficulties using the mouse and the keyboard. Secondly, we deal with age-related changes in major live functions, contrasting difficulties in remembering steps and perceiving visual information. Finally, we address user interface elements, comparing difficulties in understanding words and icons. All these findings are illustrated with real scenarios, consisting of photos and notes taken during our fieldwork. Participants gave us their consent to photograph them while interacting with the web and use these photos in our research. The notes have been translated into English by the authors, since the original conversations were in Spanish.

d.1) The mouse is more complicated than the keyboard but I want to use it

The mouse was a major stumbling block to going online. Two of the most important difficulties were the double click and the selection of text, which had a great impact on participants' everyday interactions, since the double click is one of the hallmarks of the desktop metaphor and the selection of text is also a very frequent action in editing compositions such as documents or emails.

Scenario: V (Man, 73) is using the mouse to select an area of an image and send it via email to the authors of the paper

"I more often than not need to use my both hands to deal with the mouse. This is why I have problems in putting the mouse in the correct position on the table in order to select an area, click... everything. The double-click is really difficult, as I sometimes move the mouse pointer after the first click and end up selecting things that I do not want to. I get the impression that the mouse is alive. It seems to move without making any movement with my hands"

Figure 20: Difficulties using the mouse

Difficulties using the mouse were largely overcome by using the keyboard, however. Pressing the enter key after a left-click allowed older people to double-click without relying so much on their manual dexterity[34]. Pointing with the mouse to the text to be selected, clicking once over it, and pressing a combination of keys to finally select the text allowed them to minimize the precision required to select the text with the mouse, as well as their problems in understanding the mapping between the mouse pointer on screen and the physical device on the desktop. Most of their problems were due to the fact that short movements in the physical table with the mouse could become large movements of the mouse pointer on the computer screen. However, the arrows keys provided them with a more direct and easy-to-understand feedback. This is illustrated in the following scenario.

---

[34] This combination might not work in Macintosh operating system. The study participants used Microsoft Windows.

Scenario: X (Man, 73) is selecting a sentence in order to copy it into an email to P (Man, 75), a friend of mine

"As you can see, I am selecting a piece of text with the keyboard. I tried to do it with the mouse, though it was impossible. I had to give up. However, it dawned on me that I could use the keyboard; checked my notes and this strategy works wonders. I can select the text more precisely with the arrows. Press the left-arrow, the cursor moves one position to the left. Simple. Easy. That's what older people need!"

Figure 21: The keyboard is useful

These strategies seemed to be slower and cumbersome. However, the combination of the keyboard and the mouse allowed the participants to reduce the number of mistakes they made. Being efficient is less important for older people to interact with the web (and ICT) than going wrong [41][35].

Another positive aspect of the keyboard is that it enabled older adults to write and edit their texts much more easily than by using paper and pencil. For instance, in the composition of emails and documents, they no longer needed to wonder whether other people would understand their texts because of their handwriting. This was an important concern amid participants, as they were well aware of the fact that their handwriting was difficult to read. Also, they could edit their emails and documents several times without worrying about the final presentation of the compositions - even improving it. Doing the same thing with the traditional paper and pencil, even with a typewriter, was very difficult.

---

[35] In more controlled experimentations we have also found out that searching by writing (query) allows older people to find more and faster online information than searching by clicking [32], [42].

Figure 22: Writing notes with the keyboard is easy

Despite their difficulties using the mouse, older people had a vested interest in using it, and "as the mouse is". Other possibilities, such as changing the configuration of the mouse or using other input devices were barely either used or contemplated, despite being aware of them. Whereas both the keyboard and the mouse are visible artifacts suggesting exploration, older people were much more reluctant to changing the configuration of the mouse, which is largely invisible, for fear of affecting negatively the behavior of computers. Adopting other input devices were disregarded in favor of inclusivity. This was not because of using shared computers or computers that were not theirs. Instead, participants desired to use the same things that the rest of normal people use, especially their grandchildren, adult children and friends. For instance, joysticks might have been easier to use for older people than the mouse [27], though they were reluctant towards adopting joysticks because they had seen their childre and adult children using them in order to play video games, but not to go online. In addition to this, older people did not want to give the impression that they were either frail or in need of special attention. This resonates with previous studies in Inclusive Design [9], one of its mottos being "no one wants to look disabled".

Figure 23: They want to use the mouse despite their difficulties in doing so

These findings were largely independent of previous experience with web and computer technologies. Older people with some experience were a bit more willing to explore different settings of the mouse or input devices than those without previous experience. However, in both cases, the explorations were conducted in order to know more rather than to replace the mouse with other input devices in their daily interactions.

d.2) Remembering steps rather than "things bigger" for achieving independency

As reviewed earlier, age-related changes in vision and cognition have a considerable effect on the interaction of older people with ICT. Nevertheless, our results show that remembering steps had a more negative impact on older people's everyday interactions than those due to age-related changes in vision.

Failing to remember the steps to carry out a task reduced the independency of older people in going online. Nonetheless, becoming independent users was an aspiration amid all the participants, independently of their educational levels and previous experience. They did not want to rely on anyone. They have been struggling for being independent individuals during all their life and wanted to remain being independent persons in their older adulthood. This need for independency concurs with previous studies in ageing and HCI with older people [17, 34].

Scenario: X (Man, 73) is discussing in a workshop about relevant aspects of his ordinary interactions with the web

> "*I enjoy using computers independently. When I started to use the web, I was so reliant on other people that I got the impression I was useless. I did not want to bother people, you know. Today, I am able to do my things on my own, such as watching my movies, sending emails and these things. I am very sure that the top priority for the rest of people in the session is to use the computer or go online without depending on anyone*"

Figure 24: Being independent computer users

A critical step in achieving this independency was practice, through remembering steps. Their need to practice brought to light the effects of intergenerational communication on older people's desire to be independent users, and had an impact on training strategies as well.

Both adult children and grandchildren are key members of the social relationships of older people [28]. Nevertheless, the results show that they are not good technology instructors for older people. The participants asked for help to their grandchildren and adult children, who tended to be experts at computing and were easily available to them. Nevertheless, it transpired that they explained things to their older relatives very quickly, without using words that they could understand, and did not have enough patience. However, older people were in need of words that they could understand and extra time to practice, so that they could assimilate and remember all the new information.

"I know that I ask you a lot of questions. But I want to remember how to do this on my own. Always remembering. This is the biggest problem. I do not want to rely on you, because you are not always available to help us. But I tend to forget things. I wish I could remember things better. This will help me to work on my computer at home. However, I can not get support from my children, as they are not good teachers for older people"

Figure 25: Failing to remember how to do things

Indeed, during courses and meetings, patience, perseverance, good communication and extra practice were four often mentioned qualities with a great impact on successful training strategies for older people. They thanked instructors for being patient, using ordinary language and being understanding about their need to do the same thing several times so that they could get to remember it. Even though older people with previous experience were more familiar with technical words and some concepts than those with less experience, both welcome using a plain language that helped them understand and remember technical words, in addition to having extra time to practice.

Scenario. Older people in a workshop discussing about their children and instructors in Àgora

"...So to speak, our children are not good teachers because they do not have enough patience and speak in a language that is difficult to understand. Language is a barrier. You go to the GP and start to talk in a scientific language. However, it would be much easier if they, as instructors here, are patient and speak in a way that we can understand"

Figure 26: Adult children do not help them

108

Despite the fact that the participants experienced normal agerelated changes in vision, they were totally able to interact with standard-size information such as MS Word, MS Excel, Google and Yahoo! It is worth noting that none of these technologies have been especially designed for older people. Participants were also able to interact with small-size interfaces, such as their own mobile phones, which were not those designed for seniors.

If some difficulties in perceiving visual information arise, participants either put their reading glasses on or got closer to the screen. For instance, those who had worked with some type of computer-related technology had their reading glasses ready when they started to go online. Those with less experience were not so aware of their likely difficulties in perceiving visual information. Nevertheless, they either get closer to the screen (usually, the first time) or did not forget to put their glasses on when going online (in the rest of interactions).

Making things bigger was not a solution, as it had more disadvantages than advantages. First, increasing the size of elements reduces the number of them on screen. This usually made older people lose the interaction context – information they expected to encounter is not displayed, previous elements displayed disappeared as they move up and down the scroll bar. This loss of context contributed to make older people feel unsure and less independent.

Second, increasing the size of elements also increases either horizontal or vertical scroll. Scrolling was a complicated task. And its complexity was not only because of their difficulties using the mouse. For instance, in touchable screens, whereas the precision required to scroll with the mouse seems to be reduced because of the direct interaction with the fingers on the scroll bars, scrolling is a very confusing and tiring activity for the participants. This is because of the movement of the whole arm and the blur effect caused by the small distance between the individual and the screen.

Figure 27: The screen magnifier does more harm than good

Figure 28: Scrolling is very difficult and not only with PCs

It is worth noting that our participants did not take any steps to enlarge or otherwise modify the text on Web pages. Learning from their previous experience with magnifying options, altering the size of elements did more harm than good for their daily interactions with the web. Furthermore, due to the relevance of their goals of not feeling excluded and not looking disabled, they preferred putting

110

their reading glasses on or getting closer to the screen to enlarging web elements[36].

d.3) One word says more than one icon

Whereas the terminology of interfaces typically consists of words and icons, the results show that older people with and without previous experience placed much more importance to words than icons in their everyday interactions with the web.

In conversations about going online, older adults made little or no references to icons. However, they explained to each other a new functionality they had either discovered or learned. They also discussed about their strategies for doing things, with the aim of discovering different ways of doing the same thing. In their notes, rarely did they write about icons. Nevertheless, they wrote the meaning of words in their own "language".

Except for the icons associated with main web and computer applications, such as the big E of Internet Explorer or the W of Microsoft Word, icons were largely overlooked. Participants found it more difficult to understand and remember icons than words. Words seemed to be used more consistently than icons. In addition, words conveyed the meaning of functionalities more clearly, despite the fact that some words might be computer or web jargon. Both consistency and clarity were key aspects for older people to remember an important part of how to do a task – its name and the terminology used in it. Some examples are given next.

---

[36] In other more controlled experimentations we have also found that enlarging the size of elements is not always the best approach to increase web accessibility for older people. The size of visual elements presented on the display was nowhere near as important as reducing the precision using the mouse and providing a navigational strategy that minimized the cognitive load (number of steps) in designing two web sites for different old-age pensioner associations [7, 36]. These two criteria were also of vital importance in the adaptation of a web site to its PDA version [43]. Increasing the size of asterisks is not the best strategy to help older people distinguish between required and optional fields while filling in web forms [45].

Scenario. X (Man, 73) is asked in an interview about what he writes in his notes. He is always writing down instructions and comments. He allowed us to scan his notes

"I write the most important things" Which are these things? *"The steps and the name of things that I should use"* The name of things…and the icons? *"These little images…only those that are absolutely essential. Apart from those I know well, such as save and new, the rest are quite difficult to understand. And there are a lot of them. I mean, the word 'copy' makes more sense than the image used it in Word, for instance."*

Figure 29: Words in notes

Older people with some experience got to understand the meaning of icons, as a result of their experience. Nevertheless, they were quick to point out that they paid much more attention to words than to icons, because the latter were much difficult for them to remember because of its inconsistent use.

Scenario. JM (Man, 69) is creating a folder to save new images downloaded from the web for his website. He is reading aloud the words he sees in the computer
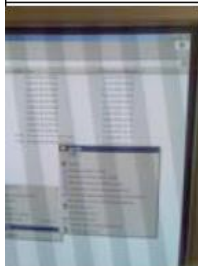
"I dot remember some little images of computers. I would know the meaning of them if you asked me, but I prefer to read words. Words are easier to remember. For instance, to create a folder, you see "create – new folder". This is a good deal easier than remembering the icons with a sort of sun in one of its corner. How will I remember that? Impossible."

Figure 30: Words on interfaces

The icon used to close an active window is very similar to the icon used to delete emails. Nevertheless, the words "delete" and "close" conveyed these different meanings in a much clearer way. Another example is the word "copy". It carried a familiar meaning to older people, associating "copy" to "duplicate". However, the icon used in applications such as MS Word was meaningless.

In addition to consistency and clarity, the name of the functionalities was the first thing that older people learned when they started to go online. In order to recognize applications, they learned to look for specific icons, such as the big E of Internet Explorer. In learning how to carry out a task, following Agora's procedures, they did not learn icons, however. They learned the meaning of specific words that enabled them to do a task (e.g.; new, copy, paste and search) rather than the icons associated to these words. Words were more important than icons. As a result of this learning process, older people stuck to words when going online.

Research has claimed that icons might be easier to understand that words for non-experts [40]. Our results show that this only appens when icons are associated with the name of main web and computer applications; words are generally easier to understand than icons, however[37].

e) Some implications for web accessibility

Is there a need for considering the prioritization of accessibility barriers for enhancing web accessibility for older people? We have seen that independency and inclusion are key aspects in the everyday interactions of older people with the web. In this sense, approaches for making the web more accessible to them that provide marginal gains such as those that might be obtained by using different input devices or enlarging web elements do not seem to be appropriate, as they will likely face serious acceptance barriers. Nevertheless, diminishing the cognitive load will be worthy of exploration, as it is one of their main accessibility barriers – both for remembering task-related steps and understanding terminology (words that are consistently used are easier to remember), related to independency. To this end, paying attention to older people's previous experiences with technologies will be an appropriate course of action. For instance, we have seen that the way older people learned how to go online had an impact on their reliance on words in their daily use with web and computer technologies. The results have also uncovered the importance of

---

[37] The terminology was much a more important design aspect than icons in designing the user interface of a video browser [2] and two prototypes based on Flickr and Blogs for senior learning in ICT [44].

social circles, especially children, grandchildren and technology tutors in the everyday interactions of older people with the web and their impact on prioritizing barriers.

We have also turned these ethnographical findings into Personas [37]. This has been done with the aim of providing inspiration for design. Even though 'implications for design' should not be the prime evaluation criteria for ethnographies in HCI (and web accessibility) and we agree with [15], we do think that they should be placed in some middle ground between naïve "implications for design" and "accept us on our own terms" [10] –ethnographies should help interactions designers to build better interfaces and they face difficulties reading long ethnographical accounts. To this end, we have created several Personas, which is an interaction design technique with considerable potential for software product development [37]. Our personas are available at: http://www.tecn.upf.edu/~ssayag/PhD

f) Discussion

We consider the novelty of the paper on the identification of and discussion about the relative relevance of accessibility barriers in the daily interactions of older people with the web. We ought to situate this main contribution to the field of web accessibility for older people into context and understand its limitations.

We have presented the relevance of web accessibility barriers within a real context of use, identifying that some barriers hinder older people's interactions more than others due to independency, inclusion and consistency in the terminology of user interfaces. Both the prioritization of barriers and the explanatory framework provide a relatively new perspective on web accessibility for older people, since very little research has gone into this issue before.

The focus on daily interactions led us to consider understanding the network of technologies that older people use in their daily interactions with the web. For this reason, even though the focus of the paper is on web accessibility, the paper reviews and makes references not only to web technologies but also computers.

The results might not be representative of several cultural contexts and older people. Also, some methodological issues imposed by the real context of use have emerged, such as the difficulties in using a combination of multiple methods (triangulation) to record participants' observations and conversations. However, both the context and the type of users with which we have worked, older people motivated to use the web and with very little educational background and digital literacy skills, make the results representative of a quite important sector: older people willing to use ITC but not especially well-off.

g) Conclusions and outlook

This paper has explored from an ethnographical perspective the prioritization of accessibility barriers in the everyday interactions of older people with the web.

The results have shown that difficulties in remembering steps, understanding computer jargon and using the mouse are much more relevant for older people to interact with the web than those barriers caused by their difficulties perceiving visual information, understanding icons and using the keyboard. The aspiration of older people to become independent computer users and go online by using ordinary technologies that do not make them be in need of special assistance or different, as well as the relevance of consistency in the terminology of web interfaces, account for the relative relevance of accessibility barriers.

Some of these results challenge accepted approaches for making the web more accessible to older people, such as enlarging the size of web elements. Other results contextualize accessibility barriers within the real use that older people who are taking up the web are making of it. Overall, this stresses the relevance of ethnographical studies in order to get a better understanding of the interaction practices between older people and the web in their lives.

Our future research lines are to use more ethnography in web accessibility for older people and explore consistency in web interfaces. Ethnographical studies should be an input to understand better older people as web users and we are reexamining our ethnographical data to get a better insights into aspects uncovered in

this paper, such as social relationships and the relevance of cognitive load, and how they can be formulated to inform the design of more accessible web (and computer) technologies for them.

h) Acknowledgments

i) References

[1] Abou-Zahra, S., Brewer, J. and Arch, A., Towards Bridging the Accessibility Needs of People with Disabilities and the Ageing Community. in W4A2008, Beijing, (China), pp: 83- 87.

[2] Arias, J. and Sayago, S. Design and evaluation of the user interface of a video browser for older people. MSc in Computer Science, Universitat Pompeu Fabra, Barcelona, Spain, 2008.

[3] Arnott, J.L., et al. E-mail Interfaces for Older People. In IEEE International Conference on Systems, Man and Cybernetics. 2004, pp: 111-118.

[4] Aula, A., User study on older adults' use of the Web and search engines. Universal Access in Information Society, 2005. 4: p. 67-81.

[5] Barrett, J. and S. Kirk, Running focus groups with elderly and disabled elderly participants. Applied Ergonomics, 2000. 31: pp. 621-629.

[6] Blomberg, J., M. Burrell, and G. Guest, An ethnographic Approach to Design, in The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, J.A. Jacko and A. Sears, Editors. 2003, Lawrence Erlbaum Associates: London. pp. 964-987.

[7] Camacho, L. and Sayago, S. Design and evaluation of a simple web site for older people. MSc in Computer Science, Universitat Pompeu Fabra, Barcelona (Spain), 2006

[8] Charmaz, K. and Mitchell, R.G. Grounded Theory in Ethnography. in Atkinson, P., Coffey, A., Delamont, S., Lofland, J. and Lofland, L. eds. Handbook of Ethnography, SAGE Publications, London, 2007, 160-175.

[9] Clarkson, J., Coleman, R., Keates, S. and Lebbon, C. (eds.). Inclusive Design: Design for the whole population. Springer, 2003.

[10] Cockton, G. Working spheres or engagements: Implications for designing? Interacting with Computers, 20. 279-286.

[11] Dewalt, K.M., Dewalt, B.R. and Wayland, C.B. Participant Observation. in Bernard, H.R. ed. Handbook of Methods in Cultural Anthropology, AltaMira Press, California, 2000, 259-301.

[12] Dickinson, A., Arnott, J.L. and Prior, S. Methods for human computer interaction research with older people. Behaviour & Information Technology, 26 (4). 343-352.

[13] Dickinson, A., et al. Approaches to Web Search and Navigation for Older Computer Novices. in CHI 2007. 2008. San Jose, California, pp: 281-290.

[14] Dickinson, A., et al., Introducing the Internet to the over-60s: Developing an e-mail system for older novice computer users. Interacting with Computers, 2005: pp. 1-22.

[15] Dourish, P., Implications for Design. in CHI 2006, (Montréal, Québec, Canada, 2006), pp: 541-550.

[16] Echt, K.V., Designing Web-Based Health Information for Older Adults: Visual Considerations and Design Directives, in Older Adults, Health Information, and the World Wide Web, R.W. Morrell, Editor. 2002, Lawrence Erlbaum Associates. pp. 67-89.

[17] Edwards, P., ActiveAgeing: A Policy Framework. 2002, World Health Organization.

[18] Eisma, R., et al., Early user involvement in the development of information technology-related products for older people. Universal Access in the Information Society, 2004. 3: pp. 131-140.

[19] Flecha, R., Sharing Words. Theory and practice of dialogic learning. 2000, Maryland: Rosman & Littlefield Publications.

[20] Gappa, H. and G. Nordbrock, Applying Web accessibility to Internet portals. Universal Access in Information Society, 2004. 3: pp. 80-87.

[21] Glaser, B.G. and A.L. Strauss. The discovery of grounded theory: strategies for qualitative research. 2006, New Jersey: Aldine Transaction.

[22] Groff, L., et al., Exploring How the Elderly Use the Web, in Usability News. http://psychology.wichita.edu/surl/usabilitynews/1s/elderly.htm. 1999.

[23] Hanson, V.L., Snow-Weaver and Trewin, S. Software personalisation to meet the needs of older adults. Gerontechnology, 3. 160-169.

[24] Hawthorn, D. How Universal is Good Design for Older Users? In CUU '03. Vancouver, British Columbia, Canada, pp: 38-46.

[25] Hirsch, T., et al. The ELDer project: social, emotional, and environmental factors in the design of eldercare technologies. in Proceedings on the 2000 conference on Universal Usability. 2000. Arlington, Virginia, United States.

[26] Hodes, R.J. and D.A.B. Lindberg, Making Your Web Site Senior Friendly. 2002, National Institute on Aging and the National Library of Medicine.

[27] Jastrzembski, T., et al., Input devices for web browsing: age and hand effects. Universal Access in Information Society, 2005(4): p. 39-45.

[28] Krause, N., Social Relationships in Late Life, in Handbook of Aging and the Social Sciences, R. Binstock and L.K. George, Editors. 2006, Academic Press. pp. 182-198.

[29] Kurniawan, S.H., et al., Personalising web page presentation for older people. Interacting with Computers, 2006(18): pp. 457-477.

[30] Larra, R.M.d., Los Mayores en la Sociedad de la Información: situación actual y retos de futuro. 2004, Fundación AUNA: Madrid. Spanish report.

[31] Macaulay, C., Benyon, D. and Crerar, A. Ethnography, theory and systems design: from intuition to insight. International Journal of Human-Computer Interaction, 53.35-60.

[32] Morales, J. and Sayago, S. Usability study of two techniques for searching online information with older people. MSc in Computer Science, Universitat Pompeu Fabra, Barcelona (Spain), 2008.

[33] Morrell, R.W., S.R. Dailey, and G.K. Rousseau, Applying Research: The NIHSeniorHealth.gov Project, in Impact of Technology on Successful Aging, N. Charness and K.W. Schaie, Editors. 2003, Springer Series Societal Impact on Aging: New York

[34] Mynatt, E.D., Essa, I. and Rogers, W., Increasing the opportunities for aging in place. in Proceedings on the 2000 conference on Universal Usability, (Arlington, Virginia, United States, 2000), 65-71.

[35] Newell, A.F., et al., Designing a Portal for Older Users: A Case study of an Industrial/Academic Collaboration. ACM Transactions on Computer-Human Interaction, 2006. 13(3): pp. 347-375.

[36] Palau, X. and Sayago, S. Design and evaluation of an accessible website targeted at the elderly. MSc in Computer Science, Universitat Pompeu Fabra, Barcelona (Spain), 2006.

[37] Pruitt, J. and Grudin, J., Personas: Practice and Theory. In Proceedings of the 2003 conference on Designing for User Experiences, San Francisco (California), 2003, pp: 1-15

[38] Randall, D., R. Harper, and M. Rouncefield, Fieldwork for Design. Theory and Practice. 2007, London: Springer.

[39] Rice, M. and N. Alm, Designing New Interfaces for Digital Interactive Television Usable by Older Adults. ACM Computers in Entertainment, 2008. 6(1).

[40] Rogers, Y., H. Sharp, and J. Preece, Interaction design: beyond human-computer interaction. 2002: John Wiley & Sons.

[41] Sayago, S. and J. Blat, Exploring the Role of Time and Errors in Real-Life Usability for Older People and ICT, in 11th International Conference ICCHP, K. Miesenberger, et al., Editors. 2008, Lecture Notes in Computer Science. Springer: Linz (Austria). pp. 46-54.

[42] Sayago, S. and J. Blat. A preliminary usability evaluation of three strategies for seeking online information with elderly people. In International Cross-Disciplinary Workshop on Web Accessibility (W4A2007). Canada. pp: 54-47.

[43] Sayago, S. and J. Blat. Adapting an online website to a Palm OS with young elderly people. in IADIS WWW/Internet 2006. Murcia, Spain, pp: 115-119.

[44] Sayago, S., et al. Meeting some educational needs of elderly people in ICT: Two exploratory case studies. ACM Crossroads, 14 (2), 2008.

[45] Sayago, S.; and J Blat. How relevant in selective attention in the design of online forms for older people? Workshop on

Cognition and the Web: Information Processing, Comprehension and Learning, Granada (Spain), 2008, pp: 101-109.

[46] Selwyn, N. The information aged: A qualitative study of older adults' use of information and communications technology. Journal of Aging Studies, 18, 2003, pp: 369-384.

[47] Smith, D.J., Senior users of the internet: lessons from the cybernin study. Universal Access in Information Society, 2005. 4: pp. 59-66.

[48] Zajicek, M., Aspects of HCI research for older people. Universal Access in Information Society, 2006. 5: p. 279- 286.

[49] Zaphiris, P., M. Ghiawadwala, and S. Mughal. Age-centered Research-based Web Design Guidelines. in CHI '05 extended abstracts on Human factors in computing systems. 2005. Portland, Oregon, USA, pp: 1897-1900

5.2   Telling the story of older people e-mailing

E-mail is often used by older people and several systems have been designed for them. Nevertheless, very little is known about how older people e-mail in their daily lives, despite the fact that understanding everyday interactions should form the basis of more useful, engaging and accessible technologies. This paper reports the most salient findings of a 3-year ethnographical study aimed at revealing and explaining the daily interactions of older people with e-mail and the use they make of it in their lives. We start by describing and discussing the nature of e-mail use. We do this in terms of social circles; frequency, type of content and patterns of communication; relationship with other technologies and activities; motivation and interactive experiences resulting from its daily use. Next, we uncover and explain the importance of several interaction barriers, such as cognitive load, difficulties using input devices and perceiving visual information, within this context of real use. We stress the significance of cognitive difficulties whereas difficulties in reading from screen are of lesser importance, differing from current HCI research with older people. Finally, we show and discuss some implications for interaction design in order to build better e-mail application (and ICT) for older people.

a) Introduction

Population is ageing at the same time that Information and Communication Technologies (ICT) are becoming integral to work, education and daily life. However, the current cohort of older people has experienced ICT for a relatively short period, which is not the most favourable situation for either learning or using them. Older people also differ considerably from the standard user in Human Computer Interaction (HCI) research (Dickinson et al., 2007) and experience changes in major life functions as a result of the ageing process (Birren and Schroots, 2001). E-mail is of great benefit to them (Lansdale, 2002) and is the Internet application they use most (Dickinson et al., 2005). While several e-mail systems have been especially targeted at older people (Arnott et al., 2004; Dickinson et al., 2005; Hawthorn, 2000), our review, discussed later, reveals inconsistent results. We argue that this inconsistency is mainly due to an insufficient understanding of the everyday interactions of older adults with e-mail, and ICT in general. An extended ethnographical study is currently missing in HCI with older people[38]. This paper contributes to this field with a 3-year ethnographical study of the everyday interactions of nearly 400 older people with e-mail and the use that they make of it in their lives. We show in this paper and now summarise how different the use and interactions are for this particular type of extraordinary users, focusing on the very relevant area e-mail.

With respect to use, we identify and explain the communication established with social circles showing that motivation, trust and support play a key role in determining the membership of older people's e-mail networks. We discuss the patterns of frequency and content of e-mails, which differs for relatives and close friends but at the same time reflects similarities and differences with ordinary communications, involving different and intense emotions regardless of the number of e-mails. We show how older people turn e-mailing into a social and intimate activity, which has an

---

[38] As stated later on, whereas much research has been focused on compensating for the effect of age-related changes in functional abilities on design and evaluation, far less consideration has been given to the natural practices of older people with ICT in their lives.

impact on reducing isolation and TV consumption while the use of other traditional means of communication is reinforced. This use for socialisation is at odds with the professional and private use for which most systems have been designed. In terms of interaction, we reveal that difficulties understanding terminology, remembering task-related steps and using the mouse limit more severely older people's interactions than do difficulties understanding icons or perceiving visual information. We explain this relative significance of barriers by two key motivations for their ICT use, independence (not relying on others) and inclusion (not feeling different or in need of special assistance).

While these findings seem to call for a re-design of e-mail systems for older people, some designs that provide only marginal improvements (e.g. making elements bigger) might not be acceptable, as they would not support inclusivity. Diminishing cognitive load appears to be a key aspect. It could be achieved by using a life-grounded terminology, through level-structured design approach and wizards. Giving support to and enriching the emotional and accomplishment feelings created in their interactions with e-mail is also worthy of attention and can possibly lead to new interfaces.

The rest of the paper is organised as follows. First, we review e-mail systems for older people and ethnography in HCI. Then, we describe the ethnographical study and present the results. Next a number of implications for interaction design emerging from the results are discussed. Finally we discuss the results and present the main conclusions, together with some future research perspectives.

b) Related work

Older people are defined here as adults ranging from 65 to 80 years old that experience normal age-related changes in functional abilities[39]. We chose to concentrate on communication inasmuch as it serves critical helping functions in ageing (Nussbaum et al., 2000). Two initial research questions guided our ethnographical

---

[39] Age-related changes in vision, hearing, cognition and mobility due to the normal process of ageing that do not limit the ability of an older person to carry out ADL (Activities of Daily Living) and IADL (Instrumental Activities of Daily Living) on his or her own.

work: (i) as functionalities play a central role in providing a good quality of interaction, which emailing functionalities are the most and least relevant and why?, and (ii) in view of the well-documented need to compensate for age-related changes in major life functions when designing for ageing, which accessibility barriers hinder older people's interactions most and why? (Fisk et al., 2004; Hawthorn, 2000).

In the remainder of this section we discuss related work on e-mail systems for older adults and their use of e-mail communication. This is followed by a subsection on ethnographical work in HCI related to our objectives.

b.1) E-mail systems for older people

SeniorMail, Simple Mail and Cybrarian are three relevant e-mail systems targeted at older people. SeniorMail is a redevelopment of the Microsoft Outlook Express interface designed to "simplify both learning and using e-mail by simplifying screen design, providing users with very simple linear search spaces with few options, increasing the size of fonts and controls and attempting to reduce both windows management tasks and scrolling" (Hawthorn, 2003; pp: 39). Simple Mail is "a simulated e-mail system with a simplified and clear user interface which had been created in consultation with older people" (Arnott el al., 2004; pp: 112). The simulator had a list of 5 essential functionalities (read mail, write mail, address book, help and close simple mail) provided in a simplified welcome window with big buttons. Cybrarian aimed to "show that it is possible to design an e-mail system for older people with no experience of Internet use" (Dickinson et al., 2005; pp: 1). Central to its development was to design simpler screens by reducing functionalities and navigation, and to increase the size of elements. The system produced was "significantly more usable, and preferred to, an industry-standard equivalent e-mail system" (ibid, pp: 19).

Common to the design of all these was compensation for age-related changes in functional abilities and a lack of experience with the technology. Neither social relationships nor interactive experiences were considered. Nevertheless, social relationships play a central role in communication (Nussbaum et al., 2000) and are also a noteworthy element in ageing (Krause, 2006). Interacting

with ICT create experiences, which ought to be considered in design and evaluation (McCarthy and Wright, 2004). This focus on accommodating functional abilities is the key and most widely spread approach within HCI research with older people. Examples range from the development of training materials and programs (Czaja and Lee, 2003; Mayhorn et al., 2004), to the design of input and output devices (Fisk et al., 2004), web accessibility (Dickinson et al., 2008; Kurniawan, 2008; Newell et al., 2006), user interface design (Hawthorn, 2000; Zajicek, 2004) and research methods (Barrett and Kirk, 2000; Dickinson et al., 2007; Lines et al., 2004; Zajicek 2006).

Nevertheless, the results of SeniorMail, Simple Mail and Cybrarian appear to be inconsistent. If we consider iconic metaphors, SeniorMail used unconventional postboxes, SimpleMail used more conventional metaphors (claiming that older people found them easier to understand), while Cybrarian used none. Taking terminology into account, whereas SeniorMail and SimpleMail speak e-mail jargon (e.g. forward and attach) Cybrarian reports difficulties in understanding this technical vocabulary. The three systems provided reduced functionality. However, SeniorMail supports window and file management tasks, which were not offered by the other two. While the approaches are heterogeneous and the results are even contradictory, the three papers reported positive evaluation. This offers a very inconclusive overall picture.

To some degree this inconsistency might be expected, as older people are a very heterogeneous user group (Nichols et al., 2006; Zajicek, 2004). On the other hand, we believe that this inconsistency is an indication that further and deeper research is warranted. Selwyn et al. (2003) and Quadrello et al. (2005) adopted a disjointed approach seeking to characterise use. Through a household survey, Selwyn et al. showed that the most popular Internet application was sending and receiving e-mails, most of the use taking place at home, where support was available from the immediate household and relatives. Through questionnaires, Quadrello et al. revealed that older people e-mailed their grandchildren who lived far away more frequently because this avoided the expense of telephoning, while grandmothers were more frequent users than grandfathers. Both studies provide very interesting but partial results about use, which is a key starting

point. In order to go beyond these results and obtain stronger evidence we undertook our ethnographical endeavour.

b.2) Approaching ethnography within HCI

There is growing awareness in HCI that in order to design better interactions the traditional focus on cognitive aspects of single users sitting in front of a computer screen and keyboard engaged in performing tasks efficiently should shift onto understanding social context of system use, interactions in the wild and experiences of people doing activities with computers in their lives (Bannon, 2000; Blomberg et al. 2003; Bødker, 2006; Hughes et al., 1995; Moggridge 2007; Shneiderman, 2002). Ethnography plays a very important role in this understanding, from the seminal works concerned with work practices (Blentley et al. 1992; Hughes et al. 1994; Suchman, 1983), to more recent studies into domestic technologies (O'Brien et al., 1999), use of mobile ICT in taxis (Elafuf-Calderwood and Sørensen, 2006) and experiences felt by teenagers sending text messages (Kasesniemi and Rautiainen, 2002). Perhaps, the main virtues of ethnography in HCI are (i) to make visible the context of system use, social practices of interactions and communities' sensibilities which might not otherwise be encountered (Macaulay et al., 2000; McCarthy and Wright, 2004); and (ii) to provide explanatory frameworks for whatever is observed that offer us new ways of imagining the relationship between people and technology (Dourish, 2006).

Ethnography has been challenged epistemologically, for instance, on its veracity (Button et al., 2000). The usefulness of ethnography in user-centred design processes has also been subjected to criticism. It is argued that ethnography is too time consuming (and expensive) and does not provide representations of real world interactions that can be used by designers. Nevertheless, the contributions that ethnography has made (and can make) to both design and further our understanding of interactions have outweighed its difficulties (Anderson, 1994; Blomberg et al., 2003; Randall et al., 2007).

Very useful techniques such as Personas, originally defined by (Cooper, 1999), Contextual Design (Beyer and Holtzblatt, 1998), and Cultural Probes (Gaver et al., 1999) have been created with the

aim of providing design inspirations and translating ethnographical results to designers. Also, a number of forms of "reduced" ethnography have been developed, such as quick-and-dirty or lightweight, concurrent and evaluative ethnography (Randall et al., 2007). On the other hand, we agree that "There is no substitute for gaining tacit and implicit knowledge of cultural behaviour than living among people and sharing their lives" (Dewalt et al., 2000; pp 291). Thus, classical ethnography is needed, consisting of a long period of immersion[40] into the daily activities of a community of people, combining observation with participation (Llobera, 2003). This is especially true if we consider that older people can be considered as "extraordinary" users, as we have argued earlier (e.g.; age-related changes in functional abilities, experiencing ICT during a short part of their lives, individual, social and environmental factors affecting the ageing process).

Some recent studies of older people have been supported by ethnographical interviews, (Dewsbury et al., 2007) in the design of applications to support older people in their own homes and (Santana et al., in press) in developing home-based communication system for older Mexican people. Nevertheless, no ethnographical studies into the everyday interactions of older people with ICT have been published as yet (Sayago and Blat, 2009), and we have carried out a long one.

c) Description of the ethnographical study

c.1) Context and participants

This study was carried out in Àgora, a 20-year-old association within an adult centre in Barcelona (Spain), from 2005 to 2008. Àgora is strongly committed to integrating into the active society fabric people who are alienated from it or run the risk of being so, such as immigrants, non-educated and older people[41]. This

---

[40] It has become relatively standard to think of a minimum of one year of fieldwork in order to gain sufficient knowledge about the everyday lives of the people being studied (Dewalt et al., 2000)

[41] About 50% of the current Catalan population has its origins from rural areas from elsewhere in Spain, the immigration taking place in the 40-50s last century, immigrants having very low literacy levels, especially women. More recently, Barcelona has experience another wave of immigration. The immigrant

integration is done mainly through informal learning in the form of free courses in a wide array of subjects, ranging from languages to maths and literature, with a monthly enrolment between 1000 and 1500 people (we will use Àgora's terminology, 'participants' throughout the rest of the paper).

Àgora and its participants consider mastering ICT as an essential element for inclusion into society. Àgora offers many courses in computing, as well as Internet access and frequent workshops. Most of these activities are aimed at older people, who are particularly disadvantaged at ICT. Let us stress that participants decide what technologies they want to (learn to) use in the courses and workshops. This decision is based on their intended use of these technologies in their daily lives, rather than on pre-established syllabuses imposed by educators. Another aspect of participation is Agora's support for dialogic learning (Flecha, 2000)[42]. As part of this pedagogy the traditional division between teachers and learners is blurred. It is common to see older people, who started courses with little acquaintance with ICT but who progressed quickly, becoming tutors in new courses offered.

Our observations and conversations took place initially in courses, which, encouraged by the participatory philosophy discussed earlier, provided us with extensive material for real use of ICT. This material is bound to differ from that that might be gathered in more artificial training settings. The participants numbered 388. They hail from different Spanish regions and live in Barcelona and its outskirts.

population in Catalonia in 2006 (Barcelona is its capital) represents 13.1% of the total Catalan population. Most of them come from Morocco, South America, Pakistan, India and Romania. These people have difficulties in their integration into society, mainly due to language barriers. A significantly deep and extensive description and analysis of the introduction of the network society in Catalonia can be found in (Castells et al., 2002).

[42] Dialogic learning assumes that knowledge is not always disseminated from the top down to students, but can flow from the bottom up, sometimes from individuals with no degree or academic background (such as older people), who would reject formal or academic activities because of a number of reasons (they think are unable to create new knowledge, scholastic skills are difficult to acquire in later life), producing knowledge on the basis of their own experience and the exchange of information with other people.

Older people living in Spain have few digital literacy competences (Informe, 2004), and 350 participants had in fact low educational levels, some having left primary school at the age of 12, some have only basic literacy skills (being able to read and write), while the rest, 38, had left school when 16. From this point of view, the participants are fairly representative of relatively deprived older people living in a developed country. On the other hand, they are motivated to (learn to) use ICT, which is not representative (Newell, 2008). They are also technology pioneers. However, they seem to show the real use that older people are making of ICT, which we believe is probably the real purpose of ethnography in this context.

The less educated participants might have used some computer-related technologies in their jobs, such as calculators and cash registers. Nevertheless, they had never used a computer or accessed the web before taking the courses. Participants with higher educational levels were familiar with basic web concepts, such as clicking and windows management. They had used some ICT in their jobs. For both, their main motives behind taking up ICT courses were: (i) not to lag behind in society, (ii) to remain closer to their nearest and dearest, and (iii) to enjoy the opportunity of learning that they did not have in their childhood.

c.2) Data and methods

The ethnographical data consists of in-situ observations and conversations in courses, workshops and meetings7. We observed and conversed with over 200 participants 2 to 3 times per week (2 to 4 hours each time) while using a broad array of ICT in courses and workshops. These activities were coordinated by one of the authors. With some 175 participants, we attended courses, meetings and workshops as observers. More details are found in (Appendix A).

Only a small number of participants (20) took part in several courses on a more or less continuous basis. They got involved in other activities of the association as well. The rest of the participants participated in at most one or two courses per year[43].

---

[43] Due to personal responsibilities – such as looking after their grandchildren or ill relatives - or due to health conditions.

Nevertheless, they went to the association weekly so as to access to Internet or to participate in meetings and/or workshops.

We wrote down our field notes. Other methods such as video cameras and tape recorders, widely used in ethnographical research, were found to be very intrusive in previous experiences: they tended to make participants feel very uncomfortable. They write down their notes and are used to seeing other people doing the same. Taking notes by using a laptop would have seemed weird.

The ethnographical data was analysed by using open, axial and selective coding and the constant comparison technique of the Grounded Theory approach for qualitative analysis (Glaser et al., 2006). We analyzed the data while gathering it (we decided to do this every 3 months) so that we could identify emerging issues and focus on them throughout the rest of our study (Charmaz and Mitchell, 2007). We identified quite quickly (by month 6) that e-mail was particularly relevant for our participants, especially because of the importance of reducing isolation and being or remaining closer to key members of their social circles. It should be noted that this is consistent with the predominance of e-mail in the courses, workshops and meetings listed in Table 4 – which is significant because the participants themselves decide the content of those courses. This reinforced our idea of focusing on the use of e-mail and understanding the interaction barriers older people face when e-mailing.

The analysis initially involved one of the authors reading the entire field notes to gain an overall sense of the data. All the data was then read again and open-coded to produce an initial code list. This was done until, in the opinion of both authors, analysis had reached theoretical saturation with the amount of information gathered so far. Most of the codes were adapted from the language of the participants. At the same time, axial coding was carried out to establish relationships between categories identified in open coding. From this basis, the data was then selectively coded in terms of core and subcategories, categories identified with the initial and axial list.

Observations and in-situ conversations in courses and workshops were complemented by twenty in-depth personal interviews lasting

one hour. They were conducted in Àgora and informed by our iterative analysis, in addition to a number of relevant previous studies into communication-based technologies with older people[44]: Eronen (2006) examined iTV applications; Reed and Monk (2004) explored the type of content of phone communication and Mitchell et al. (2007) focused on eliciting user requirements for webbased interactive TV services. We transcribed the interviews and in a second meeting we read aloud the transcription and asked the participant to either agree or disagree, or to add more information if appropriate. The interviews were conducted as the research progressed and analysed by using the methods described above.

The core categories that emerged from our analysis[45] and we will use next so as to tell the story of older people e-mailing are listed below:

- Nature of use: social circles; frequency of e-mailing; type of use and objective of the communication; geographical distance; socialisation; isolation; feeling of being alive; required and non-required functionalities; experience with paper mail; free-time use and priorities in daily life; relationship with TV and phone; emotion; accomplishment

- Interaction barriers: independence; inclusion; consistency; life experience; terminology; vision; remembering steps; input devices

d) Findings

This section presents key results of our ethnographical study. The results are divided into two sections: description of the nature of e-mailing and interaction barriers. Both sections show relevant extracts taken from our field notes. As the original conversations were in Spanish, they have been translated into English by the authors. Extracts corresponding to participants are preceded by square brackets showing [genre letter, age] (e.g. [Woman A, 68]).

---

[44] Apart from Quadrello et al. (2005) and Selwyn et al., (2003) that have been already cited

[45] We stopped the gathering of information when we identified similar patterns of behaviour being repeated which did not add anything new to the analysis.

Those extracts corresponding to the authors are identified by [Researcher].

d.1) Nature of e-mail use

d.1.1) Social circles

All participants communicate mainly with their grandchildren[46] and children, who encourage them to e-mail. These are the key members of their social circles and participants have a strong interest in e-mailing them. E-mail is a tool that allows participants to be or remain closer to them in several ways:

1) When relatives live far away, e-mailing is cheaper than speaking over the phone.

[Woman A, 67]: My children are living in the Canary Islands because of work opportunities, and giving a call to them is much more expensive than writing an e-mail. What's more, using e-mail allows me to be somehow closer to my grandchildren, who are living there too, because they are always using computers and now I can share photos and send greetings to them. It's great to be in touch with your children and grandchildren, they are very important for me

2) When older people live close to their children or grandchildren, working can hinder the contact. Phoning might not be possible at all, while e-mailing makes the communication feasible.

[Man B, 72]: My son is working downtown (Barcelona). I have not moved (he lives in the outskirts), since I am old and my son has to make his own way in the world. Even though we are not very far away, we do exchange e-mails. Sometimes he sends me e-mails from his work [...] I can't communicate with him while he is working, but

---

[46] Chat systems are preferred to communicate with grandchildren aged between 3 and 7, while e-mail is used to contact teenagers and young adults. Synchronous chat has an additional advantage of being more suitable for the writing difficulties of the aged, while asynchronous e-mail appears to be more suitable for teenagers and young adults who work or have hectic agendas (taking care of babies, for example).

as he uses the e-mail a lot, he can send me e-mails from work. I ask him some questions about e-mailing and his wok and family. It is very nice to receive e-mails from your son. You know, I am his father!

3) E-mailing helps older people to feel more included in family meetings in which references to e-mail in a work context tend to be frequent.

[Man W, 73]: Listen, I have something very nice to tell you (smile). Yesterday, we had dinner with my children. They started to talk about e-mailing, because we were talking about their work. They were greatly surprised when I broke them in and started to use these words we use in class, like attachments and e-mail address. I could join in the discussion. I still remember when years ago I got so irritated that I asked them to change the topic of the conversation when we all met together in family events. Yesterday, I took part in the conversation, and that was very important for me

This participant attaches a strong emotional significance to being included in the dinner with his children. We will elaborate on that later, arguing that inclusion is a key interaction aspect for older people.

On the other hand, half of the participants e-mail their close friends, who are also very relevant members of their social circles. Even though relatives are a source of motivation, they tend not to be supportive. They are either unaware of the difficulties their older relatives have in e-mailing, or argue that they have other more important things to do than helping them to e-mail. Moreover, if they play a supportive role, they are not good teachers for older people. They often use over technical language or do not have enough patience. Both are required aspects for older people to master e-mail. This finding can be taken as an example of under accommodation in intergenerational communication. Nussbaum et al. (2000) discuss under and over accommodation (baby talk) in several contexts of ageing, such as health care and daily relationships. Our findings show how under accommodation occurs in a real context of e-mail use and its effects on it. Close friends are a source of support and exploration, make older people feel more confident about their abilities to e-mail and are a source of

motivation to explore the technology. Email opens up another communication channel with them.

[Researcher]: Do your children or grandchildren help you to e-mail?

[Woman T, 73]: I think that I speak for the whole group when I say that they're not good teachers for us. They speak in a language we don't understand. We ask them to go slowly but they don't take any notice of that. We ask them to repeat something and they tell us that they have other things to do. The end result is, we've had to find support somewhere else. And we have found it here, in Àgora, with our friends. You teach your children lots of things, and when you need help from them, you find that they do not have time to teach you to e-mail. That's life my friend!

[Man U, 71]: Apart from writing e-mails to my grandchildren, which I think that is something that everyone my age does, I also write e-mails to some of my friends. In fact, they persuaded me to learn how to e-mail, to share photos and other information we have in common and to establish another way of getting in touch with each other. We do lots of things together and learn from each other. Friends are very important in my life and I think that happens in everyone's life, so having e-mails from my friends is very valuable.

The importance of close relatives and friends in e-mail communication concurs with previous studies of social networks, social support and sense of control in ageing (Antonucci, 2001). Nevertheless, our participants do not use e-mail to make new friends, unlike previous studies with older Japanese people (Kanayama, 2003). In our study, both men and women rely a lot on traditional and, in their view, safer strategies to meet new people. Our participants show a strong preference for e-mailing their close friends because they are trustworthy people. This reluctance to meet unknown people and the relevance of "trust" in e-mail communication can be accounted for by social emotional selectivity theory (Carstensen, 1991), which claims that as people age they are likely to drop relationships that are less important to them or create bad feelings.

[Researcher]: You know you can meet people by using e-mail. What do you think about that?

[Woman H, 79]: Well, I'm not interested in it at all. I have my friends and my relatives. And I know that they are good people. If I wanted to meet new people, I would travel, or go to school, to the gym… This is how people my age met their partners and made friends… I think that it's much more natural than just writing e-mails. What's more, I have heard that meeting people online can be dangerous, and I don't dare to take any risks at my age, you know.

[Man Q, 75]: I totally agree with her. I love meeting new people, you know that. I think that we learn a lot when we socialise, and that's very important when you are an old person. But I prefer to stick to the things that I know work well. Meeting people by e-mail might work for those older people who cannot go out, such as my neighbour, but for those who still have some energy, we go to the places she told you before in order to socialise and meet new people.

d.1.2) Frequency of use and content

Participants communicate relatively infrequently with their grandchildren and children, 4to 6 e-mails per month. If they communicate with their friends then they do so more often, with 3 to 5 e-mails per week. The body content of the e-mails to relatives is longerthan that to friends. While personal and family affairs are usual matter of their messages to relatives (e.g.; asking how the children are settling down in a new flat or explaining aspects of their everyday life), with their friends they share photos, jokes, information (most of it downloaded from the web), or suggest going for a drink. The exchange is seen as largely symmetrical with friends, while with relatives older people do not expect replies of the same length and frequency as the ones they write.

[Researcher]: How often do you e-mail, [name of the participant]?

[Man M, 69]: It depends. I send two or three e-mails per month to my grandchildren and children. They are busy working and studying, so they do not have a lot of time to write me. But all the

same we are in touch by e-mail, despite that. I send more e-mails to my friends, but don't think I send a lot. Between 3 and 4 a week. We share photos and jokes, mainly, something to pass the time".

[Woman P, 75]: I get more e-mails from my friends than from my adult children or grandchildren.

[Researcher]: Why?

[Woman P, 75]: Well, because they are busy working and studying; we send two to three e-mails per month, just to ask how things are going. However, with my friends, we share lots of things, like gossip, jokes, information about our hobbies, etc. You don't talk about the same things with your relatives as you do with your friends, you know.

[Researcher]: Where do you find this information?

[Woman, 75]: We take this information from the Web; there are lots of things there

The previous extracts, in particular the sentence "You don't talk about the same things with your relatives as you do with your friends, you know" indicate that differences in communication patterns in the real world are mapped onto the digital domain. Nevertheless, some patterns are not translated into the digital realm. Namely, e-mail is very little used when something bad happens to relatives or friends. Instead, more traditional communication channels, such as face-to-face conversations and phone calls are preferred. They are regarded as a more personal and appropriate way of communication for serious matters. In this case, hearing the voice of another person, touching and seeing him or her creates the atmosphere that is needed when something bad occurs and e-mail does not seem to provide this.

[Woman Z, 70]: I like spreading good news. For instance, I recently sent my friends the photos of the wedding of my daughter. But we were sad because one of my grandchildren was operated and couldn't enjoy the wedding. He went to the Church, but in wheelchair. I didn't send a lot of e-mails when my grandson was in

hospital; I wasn't in the mood. Even when he got better, I didn't announce it by e-mail…

[Researcher]: May I ask why not?

[Woman Z, 70]: Yes, you may! Because in that kind of situation we talk by phone and in person… e-mails aren't good for talking about serious matters, you know.

[Woman G, 72]: I was with her. She phoned me. We need to be there, with the person, when something bad happens.

The frequency of use and the type of content described before is dynamic. Older people e-mail more often in special events such as birthdays, Christmas and weddings, and the content of e-mails also changes.

[Man B, 68]: I do send a few e-mails, just to my children and grandsons, and some friends. But I must admit that I can send at least 20 e-mails in Christmas. I like sending Christmas greetings to all my relatives. My son, who has studied graphic design, designs the greetings. This is a sort of tradition in my family. But apart from that, I don't send many e-mails; well, I think that I send the e-mails that I need to.

The last sentence is worth discussing. Despite being aware of sending few e-mails, the number of them is appropriate for the participant's type of e-mail communication. This suggests that the perceived value of e-mailing does not depend on how many e-mails are sent or received. Instead, it lies in the socialisation and the emotional experiences associated with them, as we discuss later on.

Participants do not e-mail their siblings or partners, despite being very relevant members of the social circles of older people in other contexts, such as health care (Krause 2006). They do not seem to be a source of either a stimulus for communication or support. Participants find it odd to communicate with their siblings and partners through e-mail. Also, some sort of division of labour between partners, as happens in other daily activities, such as

driving or mastering the TV controller, can be a pattern for shared email use.

[Researcher]: And you, do you e-mail your brothers and sisters?

[Woman W, 72]: No, I don't really e-mail them, although they are online.

[Researcher]: Why is that?

[Woman W, 72]: Because we're all grandmothers, so we want to talk to our grandchildren and children. But we don't use e-mail to talk amongst ourselves. Well, sometimes we send photos, but we don't use it much. We either pop in or ring. It's a bit odd to e-mail your sister. We e-mail the younger generation or our friends.

[Researcher]: What does you husband think about you e-mailing?

[Women I, 65]: He doesn't mind. But he does not like to think too much. He is tired, he says. What's more, he has the cheek to tell me that with one of us being able to e-mail our children and grandchildren, then that's enough. When the computer is ready, my husband comes over and starts to dictate what he wants me to write.

[Researcher]: Really?

[Woman I, 65]: Yes, but I take my revenge, and he has to drive and explain to me how I can set up the TV using the incredibly complicated TV controller!

d.1.3) Geographical distance and relationship with other ways of contact

The frequency of use and type of content described above is largely independent of the geographical distance that separates older people from their relatives[47]. Nevertheless, emails sent to relatives living far away tend to be longer than those sent to relatives living nearby. Participants also tend to spend more time writing these e-mails, in

---

[47] Participants do not have friends living far away.

that they try to compensate for the lack of "direct" contact with them - as they did in traditional letters.

[Woman L, 75]: […] I have children here in Barcelona, Portugal and Germany. [details about her children] When I write to the ones who live far away, I spend nearly 30 minutes writing. Lots of things in my e-mails…[smile] But, when I write to the ones living in Barcelona, because I see them much more frequently than the ones in Portugal, I don't spend so much time. Maybe 5 or 10 minutes, no more, for sure.

If relatives live far away, the phone is much less used, because of cost savings.

[Woman M, 69]: […] I have my children working and living in France. They urged me not to use the phone to talk to them because it would be very expensive. Instead, they encouraged me to learn to email, and now that I have learned more or less, we write e-mails. I do give them some calls as well, but not very frequently.

While this is in agreement with (Quadrello et al., 2005), our work does not confirm their observation that proximity with relatives reduces e-mail communication in favour of face-to-face or phone conversations. Instead, e-mail reinforces this traditional communication in two ways, described below:

1) Participants phone friends up to inform them that they have sent an e-mail

[Researcher]: Does the e-mail affect your use of the phone?

[Man K, 66]: I use the phone in much the same way I did before e-mailing. You know that you can pay for both things, and using one more than the other doesn't matter. Also I sometimes give a call to my friends (and children, grandchildren) so that they know that I have sent them an e-mail.

2) Information exchanged by e-mail becomes the topic of face-to-face communications

[Man 68]: I talked with my grandchildren, children and friends about our e-mails. When I meet my friends, we start to talk about the document that somebody sent us, the joke that I sent to them a week ago, or someone that has been sending lots of e-mail during that week. With my children and grandchildren we do the same. We talk more, and about more relevant things, I think.

d.1.4) E-mailing and other daily activities

While phone and face-to-face communication do not decrease, participants watch much less TV. This reduction is due to the fact that participants feel much more useful when emailing than when watching TV. As a result, they become more selective about the programmes they watch than they used to be.

[Man K, 66]: ... But I must admit I watch less TV. I learn when I'm e-mailing, I feel that I am doing something useful. I don't have the same feeling when I watch TV

[Researcher]: Does it affect your use of phone and TV?

[Woman E, 80]: No, not the phone. I don't pay more for e-mailing and phoning. There are even some issues, such as illnesses, that should be talked about on the phone. But, I must admit that I watch TV much less. Now, I decide what I want to watch on TV, and I spend more time working with my PC, emailing and doing other things online.

E-mailing does not replace other relevant activities such as going for a walk, travelling or paying visits to friends and relatives. Instead, e-mailing is considered to be another very valuable activity that fills their free time but, at the same time is not a high priority one in their daily life. This priority could be increased if e-mailing was a working tool.

[Man C, 65]: I a'not forced to e-mail. My son has to e-mail at work, you know, he even e-mails at the weekends. I e-mail because I like to be in touch with my little grandchildren and children. But I have to say that e-mailing doesn't prevent me from doing other things. For instance, I walk 20 Km everyday. It is good for me. And, if one

day I can't e-mail because I have to go out with my wife or something, it doesn't matter. I can read my friends' and relatives' e-mails the next day

[Man O, 78]: We do not need to e-mail everyday, not like we had to go to our farms to take care of our animals and machines day in, day out, when we had to work. We take our time to send and read letters, when we feel like it

d.1.5) Socialisation, emotion and accomplishment

Participants turn the individual e-mailing into a social activity, as their main motivation for its use is socialisation. They avoid doing activities that can isolate them further. Although e-mailing allows them to remain closer to their social circles, doing so from home is considered as a potentially isolating activity. Participants feel that there is little point in e-mailing their children if this makes them spend more time alone. Not only has e-mail has to reduce isolation digitally but also physically. Participants appreciate the company of close friends when e-mailing, even when they have computers with Internet connection at home. Less than 8% of the participants e-mail from home. The rest of them e-mail from the association. Those who have a stronger preference for e-mailing at home, do so because of reliability.

[Researcher]: Where do you e-mail?

[Man J, 75]: I e-mail here, in Àgora (the association). I walk here every day. Whe I get home after having walked around the city for a couple o hours, I have a shower, my breakfast, and then head towards Àgora. I check my e-mail. 30 minutes, more or less. And I probably meet some friends, and go for a drink. I do that every single day.

[Researcher]: Do you have computer at home?

[Man J, 75]: Yes, I have. And with Internet. But I prefer to go Àgora.

[Researcher]: How come?

[Man J, 75]: Because at home you are alone, or your wife is interrupting you…I go to Àgora, and have a chat with people there

[Researcher]: Where do you e-mail?

[Man P, 72]: I mostly e-mail at home.

[Researcher]: Why?

[Man P, 72]: Because I have my room for the computer, with high-bandwidth Internet connection. It works better than the PCs in Àgora.

[Researcher]: But I have seen you here, e-mailing…

[Man P, 72]:Yes, it's true. I do that several times a week. Having a computer at home shouldn't mean being tied to one place and not moving. That's what I think. I have my computer, and if the computers don't work in Àgora, I can check my e-mail at home. But of course I e-mail and do other things in Àgora. I can't spend too much time at home, and I need to see the street!"

This "social" e-mailing by older people differs from the current predominance of individual and private e-mail for other population ages. Participants e-mail with close friends nearby and allow them to read their messages. Close friends read e-mails together as a way of sharing good and bad times, news or information. This is a sign of trust and friendship. Intimacy is preferred over privacy. It is worth noting that very similar results were found in a study of the use that teenagers make of mobile phones – they swapped their mobile phones to read each other's messages too (Kasesniemi and Rautiainen, 2002).

[Woman W, 74]: Maria, Pedro, please come over, quickly! Look, I've got a photo of my grandson. He's four. He's so cute, isn't he? Please read on, you might give me a hand. Her mother tells me that she's having problems in feeding them. He does like vegetables, but he should eat them. I was about to tell her to try doing… but, what do you think? (Maria and Pedro answer). Umm... I'll reply to her. Please, let's do it together because I want to tell her what you have

just told me. And I do not want to forget anything. I want to use colours too but I don't really know how to do it. We can do it together, can't we? [Maria and Pedro] Yes, sure. Better three minds than one old brain!

The joy of receiving e-mails from grandchildren and children is not related to the number of e-mails in the "inbox". When somebody who is very important for older people cares enough about them to send them an e-mail while they are at work, or just to ask how they are, it makes participants feel meaningful, special and still important to people they love. Reading children's e-mails creates quality time, in which efficiency or performance aspects of the e-mail as a working tool play no role.

[Researcher]: [...]have you heard that, he e-mails a lot!

[Man I, 68]: He receives more messages from his relatives than me, for sure. But I have to say that I don'ot need many e-mails. Having something to read, and knowing that this piece of writing has been written by a person you love, is very valuable for me.

[Woman U, 65]: Yes! The same for me. I don't think the number of e-mails makes any difference. The most important thing is receiving and sending...I even think that too many e-mails would be a bother for us...we want to take it easy"

[Man R, 78]"When we worked, we were under pressure. We were in a hurry and we had lots to do. We didn't enjoy ourselves much. I think that I speak for the group when I say that we don't use e-mail as a working tool. We don't want to. We enjoy sending and receiving e-mails. We feel very good when we see an e-mail from our grandchildren; they find time to write to us, and we enjoy having time to read and re-read the messages, even printing them out!

E-mailing creates a feeling of accomplishment. Participants are well aware that their ICT involvement contradicts sociological stereotypes. The images portrayed about older people in mass media (TV, newspaper and radio) tend to be negative (Robinson et al., 2004). One of these widespread stereotypes is that older people and

new technologies are antagonistic species. These negative images permeate the lives of older people and are potentially harmful. Nevertheless, e-mailing accomplishment "contravenes" these social rules, boosting their self-esteem and creating the feeling (difficult to explain with words) of "despite being old, we can".

[Researcher]: You are exited today. Have you won the jackpot?

[Woman I, 73]: Better than that. Have you ever realised how important is it for me or for older people to email?

[Researcher]: I'd like to hear your ideas

[Woman I, 73]: There are no words. Apart from being in touch with our nearest and dearest, and being more active, and all the things you can see here, we are teaching ourselves that we can still do things that people believe we can't do because of our age. We are showing them and ourselves that we can. I never thought I would be able to e-mail, especially because I only studied until I was twelve. And I'd never touched a computer.

[Woman O, 68]: You said it. I've put a lot of effort into e-mailing. Getting the e-mail to work has been a very big achievement!

e) Interaction barriers

e.1) Inappropriate and excessive functionality

A number of functionalities are inappropriate for the type of use we have described. For instance, participants do not use BCC since they do not need to hide a person in their communications.

[Man R, 70]:And..let me tell you another thing. This BCC will probably be very useful for you in your work, but we do not use e-mails for work. We write e-mails to our friends and relatives, so we do not need to make people invisible in our e-mails"

Other functionalities aimed at an efficient management of e-mails and addresses are not really needed, as participants exchange few e-mails with few people. Participants are overwhelmed by the

functionalities provided by e-mail systems. Participants feel that systems ought to be simpler. By simplicity they mean having a number of functions which is appropriate for the way in which they communicate.

[Man, 76]: I think that e-mails have lots of features, even more than we need.

[Researcher]: Why makes you say that?

[Man, 76]: Because we write very few e-mails, especially compared to young people who are always sending and receiving e-mails.

[Researcher]: What do the rest of you think?

[Man V, 66]: I totally agree with him. E-mail programs have many things. I think that we need something simpler. We only exchange e-mails with a few people and some things like these…filters…addresses…and options and all that jazz is over the top.

[Woman O, 67]: Take it easy, my friend. I'm sure someone needs all these advanced things, like organising e-mails. I know that because my daughter works with e-mails every day and uses all those features. But we just need something that allows us to send and receive e-mails, nothing more.

e.2) Managing attachments and e-mails: making e-mail their own

Participants do not manage their attachments, pictures or documents, as other age segments do. They just open attachments, without saving them. This reduces cognitive load - less remembering needed and more clues for retrieving. Opening attachments is also related to their life experience with paper mail.

[Man P, 72]: How can I see this picture?

[Researcher]: You can click over here. And you can either save it or see it.

[Man P, 72]: No, I want to see it.

[Researcher]: Don't you want to save the picture in a folder?

[Man P, 72]: Will it be in this e-mail next time?

[Researcher]: Yes, this picture will be in your e-mail unless you delete the message.

[Man P, 72]: So, that's ok for me.

[Researcher]: Why?

[Man P, 72]: Because it is easier. Let me tell you that I still have some old photos my wife sent me by post, and they are in the envelope. I can read her letters and see her photos. What's more, I don'tt need to wonder where they are. I should be able to remember they are in the envelope.

[Researcher]: And in the computer?

[Man P, 72]: The same thing. I can create a folder anywhere and save the photo there. But it's another thing to remember where I put the photo! Having the photo in the e-mail makes my life easier. At least I only need to go to the e-mail!

Received e-mails are not organised either. Contrary to what we initially thought, participants do not separate e-mails from friends and relatives into different folders. Participants only keep those e-mails they like most or are very important to them, despite the low number of e-mails received, especially those sent by their relatives. Other e-mails are deleted in order to save space. This deleting strategy is related to their old habits with paper mail and also reduces cognitive load. We will discuss this further below.

[Researcher]: You know that you can organise your e-mails into folders, don't you?

[Woman S, 74]: Yes, I know. But…why do I need that? I receive very few e-mails, and I think that having folders would be more difficult than having all my e-mails in a single place"

[Man X, 70]: I only keep those e-mails that I like most. I see the photos or documents my friends sent to me. If I like them, I keep them in the e-mail and send them to other friends. But if I don't like the e-mail very much, I just delete it so that it does not take up too much space.

[Researcher]: What do you mean by space?

[Man X, 70]: I am doing the same as I do with my paper mail. I still have some lovely letters… and I have a record of the bills, of course. But if I receive things I don't like, I just throw them in the bin"

e.3) Do not hurry

Avoiding making mistakes is a good deal more important for participants than being efficient. We have found this preference in general computer use as well (Sayago and Blat, 2008). The main reasons are:

1) At their initial stages of learning, older people are afraid of using computers. They are under the illusion that they can either break the machines or delete important information stored in them.

[Man L, 73]: Computers have very important information and are expensive.

[Researcher]: Why do you say that?

[Man L, 73]: I have seen my grandchildren and children studying and working with them. They have all their life there. Here we work a lot with computers, so I don't want to damage that computer because it might have other people's information and Àgora would need to spend a lot of money repairing it. So, I prefer to go slowly and take steps when I'm sure of my ground

2) Making mistakes is associated to rushing and against their pleasant use of e-mail.

[Researcher]: Come on! The faster you go, the more e-mails you can send!

[Male T, 74]: Slow down! We, and I speak for all of us, don't need to rush; really, we don't want to use computers in a hurry, not like you! We want to take our time, because we have been rushing all our lives; before, in our jobs; and now, with our grandchildren. We want to relax and use computers slowly

3) Making mistakes places extra cognitive demands to overcome errors

[Researcher]: But, come one…this sounds very like the typical image of older people, you could try to be a little bit more efficient!

[Man E, 65]: (smile). Let me tell you something. The faster I go, the more mistakes I make. And, the most important thing is this: if using computers is a hard task for oldies, as you sometimes say!, you can't imagine how difficult it is to recover from your own mistakes, when you have no clue about how to fix them!

4) Making mistakes frustrates their goal of independency

[Woman U, 70]: It is very frustrating not to be able to do things with this machine on your own.

[Researcher]: Don't despair!

[Woman U, 70]: I know, but the point is that I have been able to bring up my three children, working at the same time, and taking care of my mother and husband. And I haven't needed help from anybody. But I cannot move forward on this screen unless you help me.

e.4) Using the mouse and the keyboard; alternative devices

The keyboard is useful: it makes their process of writing easier and clearer. Participants only use the most basic aspects: letters, lower and upper case, punctuation symbols. However, they find advantageous the editing functionalities. The keyboard also helps them to make their notes readable to others, which might not be the case with their handwriting.

[Researcher]: You are always complaining about the mouse, but I have never heard you complaining about the keyboard, which you use to send e-mails as well.

[Man H, 75]: The keyboard is not a problem for me. Once I learned how to use capital letters and other symbols, writing with the keyboard is really easy, and even easier than using paper and pencil. You know, I can choose different sizes and fonts, I can write, delete and write again without worrying about the paper or the pen, and I'm 100% sure that people will understand my handwriting! But the mouse is a headache. Sometimes it does't move in the direction you want it to, and my hands are older"

The mouse is more difficult to use[48]. Even so, they reject alternatives because of their wish to feel integrated. When asked about the possibility of using alternative input devices, they refuse point-blank. It could give the impression that they are either different or in need of special assistance. Participants wish to use things that people, especially their grandchildren and children, normally use when interacting with computers. This need for inclusion resonates with the hallmark of Inclusive Design (Clarkson et al., 2003): no one wants to look disabled.

[Man Q,73]: I don't want to use special things. I don't think that I'm stupid. And I'm not in need of special help. I want to use the things that people use. I know that I'll have more difficulties because of my age. But being old should't mean that I can't use the mouse.

[Woman U, 70]: Joysticks? I think that my grandchildren use them to play videogames, but for sending e-mails, they use the mouse. Imagine if they saw me using a joystick to send e-mails…I do not

---

[48] Due to normal age-related changes precision problems and declines in manual dexterity

want them to think that their grandmother is frail. I do have problems using the mouse as you can see…but I'll have less problems tomorrow.

e.5) Perceiving visual input and difficulties remembering steps

Participants use regularly sofware with standard-sized information, such as MS Word, Google and Yahoo! They also own interfaces with small-sized elements daily, such as their mobile phones, which are not specifically designed for older people. This contrasts with the very relevant difficulties in remembering steps.

[Woman R, 72]: We always get stuck at the same point. You have explained the same thing to us lots of times, but I still have difficulties remembering how to send a photo. I have to repeat and repeat it so that I can remember some steps. But even so, I still have problems remembering the steps. I think there are too many!

[Man O, 68]: The size of the letters on the screen is ok. I mean, I wear glasses to read my newspaper, so if I have problems in reading the computer screen, I put my glasses on and the problem is over. But the solution is not so easy when I have to remember how to do something with the computer. I think that I, and old guys in general, need to do the same thing many times so that we can get to remember how to do it. For instance, when I finish my class, I go back home and I remember things. But if I don't use the computer for a week, I forget everything! It's very frustrating!

Failing to remember steps reduces the independence which all participants aspire to. They have struggled to be independent individuals during all their lives and want to remain independent in their older adulthood with computers. The relevance of independence concurs with the study of Schaie et al. (2005) on everyday competence in older adults, in which it is claimed that one of the prevailing concerns as individuals enter older adulthood is the ability to maintain an indepenent lifestyle. However, out study situates "independence" into the context of real e-mail use (and ICT) and shows its impact on the relative significance of interaction barriers, which is not addressed by Schaie et al.

150

[Woman F, 68]: I know that I ask you a lot of questions. But I want to remember how to do this on my own. Always remembering. This is the biggest problem. I don't want to rely on you, because you are not always available to help us and because I have to do it on my own. But I tend to forget things. I wish I could remember things better. Tt would a lot with e-mail.

[Man X, 72]: I enjoy e-mailing and, in general, using computers, independently. When I started to e-mail, I was so reliant on other people that I got the impression I was useless. I did'tt want to bother people, you know. Today, I'mm able to do my things on my own, like watching my movies, sending e-mails and that kind of thing. I am very sure that the top priority for the rest of thepeople in the session is to e-mail and use PCs or do whatever they want without depending on anyone

Participants do not enlarge or otherwise modify the text when e-mailing. Altering the size of elements does more harm than good as it reduces the number of elements on the screen and increases horizontal or vertical scroll, making tasks more complicated. In terms of their inclusion goals, they prefer to put their reading glasses on or get closer to the screen (Sayago and Blat, 2009).

e.6) Terms and icons

Participants have difficulties understanding e-mail terminology, for instance they asked us a lot about the meaning of "attaching" and "forwarding", but very few questions were asked about icons. However, this seems to be unrelated with the claim that they can be easier to understand than words for non-experts (Rogers et al., 2002). Participants do not write the meaning of icons in their notes. Instead, they write the meaning of words (e.g.; equating "attach" as "send an e-mail with a photo"). Except for the icons associated with main web and computer applications, such as the bird in Mozilla Thunderbird, the big E of Internet Explorer or the W of Microsoft Word, icons are largely overlooked. Participants always look first for the name of the functionality rather than the icon associated with it, and this is because terms convey the meaning of functionalities more consistently, which helps older people to remember them more easily. In general this holds for all their computer use.

[Man W, 68]: We first learned the name of the functionalities and where they were. We prefer to stick to what we know, because it makes us feel comfortable and we made fewer errors.What's more , we think that words or names are easier to understand than images, especially those used in computers. They may be easier to understand for you, but for me, for instance, better "delete a message" or "save a message" than click on a 'red cross' or 'on a disk', which I find difficult to remember.

[Researcher]: If you click on this icon, you can delete an e-mail.

[Women S, 74]: Ah! I did't notice this icon.

[Researcher]:Did you see it?

[Women S, 74]: Yes, I'm nott blind! What happened is that I was looking for the "delete" option, I mean, the word, because I think that every application uses different images [referring to icons], and I have to remember many different things…it makes my life difficult! (smile).

f) Some implications for interaction design

Older people wish to be independent and ordinary computer users. Thus, a first pertinent question is whether there is room for e-mail systems specifically designed for older people. Design approaches aimed at providing only marginal gains, such as those that might be obtained by using non-standard input devices or enlarging system elements, would face acceptance barriers.

Consistent terminology which is grounded in everyday life appears to be something that would not differentiate older people from younger adults, so it would be worth considering making an intervention in this area. This issue is related to reducing the cognitive load barrier, which from the evidence gathered in terms of strategies of use, seems to be a key factor for older people. Also related to cognitive load is the possible reduction in the difficulty of remembering steps to perform functionalities. This difficulty tends to be permanent, as the e-mail use of older people is not very frequent, and thus it is worth exploring. A possible strategy is the use of wizards. There are only a few e-mail functions that are used

by older people. Hence, wizards might provide a stable guide for them to e-mail. Wizards are also used by some irregular users and can be either removed or hidden if necessary. A complementary option could be a level-structured approach to design (Baecker et al., 2000), which would begin with basic functionalities and options and allow for more complexity depending on the evolution of use.

All the above issues can be either incorporated as modifications of existing systems or implemented in the development of e-mail systems from scratch. A new type of interface which supports and enriches experiences would also be worth considering. Affectionate interfaces when e-mailing grandchildren and children, allowing personal and long e-mails with direct access to personal photos; friendly and intimate interfaces when e-mailing close friends, with links to online resources that appeal to both of them integrated in e mail systems and allowing the experience of sharing private messages; and cheerful interfaces congratulating older people for having achieved something difficult after a lot of effort would provide a better quality of interaction.

As we indicated earlier, Personas is a technique introduced in order to communicate ethnographical results to designers by drawing their attention to "models" of users. In this paper we have chosen to let the real users speak –selecting carefully only very few and relevant fragments of a 3-year study - and a Personas expression might be either repetitive or too simplified. In a web related to this paper[49] we have selected pictures that complement the voices of the participants. The Contextual Design models, especially their graphical representation, could be also too simplistic for the results we have presented. We feel that photos can help us make a stronger and richer connection between the voices of our participants and the reader by showing "this is what this meant to older people as e-mail users".

g) Discussion

We hope the reader has found the results compelling. Nonetheless, we should situate them into context and understand their limitations.

---

[49] http://www.tecn.upf.edu/~ssayag/TellingOlderPeopleStoryEmailing

We unveil and explain the nature of use of e-mail by older people and its relevance for their communication and lives. We identify, describe and segment social circles, patterns of frequency of use and content that map and do not map from the real world to the digital realm. These include motivations, expectations and interactive experiences, amongst other details (such as the relationship with other technologies) that are important for the researchers to understand much better the whole story of older people e-mailing. All these aspects potentially enrich HCI research with older people, but we tried to report only those aspects of our 3-year ethnography which are quite relevant for HCI and email. On the other hand, we did not adopt an over restrictive strategy, which might hinder comprehension of the story – although quite a lot of our non reported work might be relevant for other research fields.

While the interaction barriers discussed are not really new, what is new with respect to widespread accepted research is to modify their relative relevance by placing them in a context of real use, in which compensating for age-related changes in functional abilities is not the only thing that matters. As we have seen, cognitive load is a much more important factor, as seen from the strategies of use and other evidence, and we have indicated some paths for improving design.

We do not claim that the results are representative of different cultural contexts and we have indicated some differences already appearing in previous studies. However, the context we have described, consisting of motivated users with scant educational competences and previous experience with ICT, makes our participants a very important (and growing) sector: run-of-the-mill older people willing to use ICT. For these users, email has a strong impact on their quality of life; contradicting reports that computer use has no demonstrated impact on the well being of older adults (Dickinson et al., 2006). In addition, they accept, are excited by and want to use e-mail, challenging the widely spread view of older people as computer users, recently captured in (Newell, 2008; pp: 11) "older people are much less confident with and accepting of information technology and […] are less likely to be excited by, or desirous of learning to use, unfamiliar technology". Thus, understanding them and their needs is very important for improving HCI research. However, other segments of the older adult

population might have different problems, motivations, etc. Further ethnographic research should help to go move this research forward.

We claim that the various points we have stressed as being important are the ones which are most relevant. We are aware that no ethnographical study is value free and very little ethnographical research with older people and ICT has previously been carried out. For this reason, rather than following a "reduced" form of ethnography developed for HCI, we adopted a classical approach with the aim of observing, collecting and analysing important items carefully and progressively, as we have discussed in the methodological section. We have also registered some surprises, compared our results with the literature, and shared debates between the two present authors on the interpretation of our results. We have adopted a classical ethnographical way of expressing results, letting older people tell their story. However, the selected texts are representative of what we have both observed and analyzed: we are fully aware that participants could have been telling lies or simply saying things that correspond to their stereotypes or misrepresentations and not to facts. On the other hand, we have run some more quantitative experiments on some of the issues, which corroborate our assertions[50].

We have provided some inspirations and implications for interaction design. In so doing, we have run the risk of either oversimplifying or hiding the complexity and richness of the ethnographical insights. How ethnographical-driven results can or should be translated to design and by whom is an open and current debate (Cockton, 2008).

---

[50] We have explored the interactions of older people with online forms in two different contexts and shown that increasing the size of asterisks does not make older people fill in forms more correctly. We have designed three web sites for three different retired persons associations and found out that increasing the size of web elements is much less relevant than better navigational structures that help older people to interact with fewer and clearer clicks. A similar finding was found adapting an online web site to its mobile (PDA) version. Terms were also more relevant than icons in the design of a video web browser, blogs and Flickr prototypes in Àgora and in another retired people association. We have also found that searching by writing the query allows older people to find more information and faster than searching by clicking. These studies are detailed and listed at the following web address:
http://www.tecn.upf.edu/~ssayag/TellingOlderPeopleStoryEmailing

Finally, a remark should be made with respect to gender differences. One of our concerns was to understand them, as previous studies in the maintenance of social relationships over e-mail show gender differences (Boneva and Kraut, 2002). We have not found them in any of the aspects we have discussed in this paper.

h) Conclusions and future work

We have explored through a detailed ethnographical study the way older people e-mail in an attempt to use this type of studies to ground improvements in the accessibility of email systems and other ICT. We have focused on a communication tool, because we deemed it key for the users' activities.

We have revealed that older people use e-mail in their free-time within a restricted social circle, which consists of two different groups: relatives (with a frequency of few e-mails per month but quite detailed and emotionally significant communication), and close nearby friends (with few e-mails per week exchanging some web based information for socialising). This use has little to do with office work context which e-mail systems were designed for. Our users send, reply, forward, attach, and view attachments, while functionalities such as managing messages or addresses are largely irrelevant.

Older people are motivated to use ICT because they perceive this as being an important factor in being included in contemporary society, from which they do not want to be excluded. They use glasses instead of large font sizes and think that it is inappropriate to use input devices alternative to the mouse, since they want use ICT in a similar way to their social circles.

Cognitive load is their most significant ICT accessibility barrier: they do not save and manage attachments within the computer file system as this would add more things to remember. They also find it difficult to remember task-related steps. Icons are largely ignored while understanding the terminology is their cognitive strategy. This understanding is closely associated to a "mental model" of the traditional paper mail, which might be a useful metaphor.

Individual and private e-mailing is turned into a social activity building intimacy, sending and receiving e-mails in the company of close friends and allowing them to read their messages as a sign of trust.

Some of these findings challenge currently accepted views on the relative importance of different accessibility problems to older people, and stereotypes about their (lack of) motivation to use ICT or their actual use of these technologies. Other findings offer a new way of looking at the interactions between older people and ICT. This stresses the importance of ethnographic methods and ascertaining use, social circles, motivation and interactive experiences for dealing with accessibility barriers (and thus, designing better interfaces for older people).

Let us conclude this paper by indicating some of our current lines of research. First, motivated by the importance of the paper mail metaphor or mental model, we will be exploring this aspect as framed in the importance of lifelong experience for older adults. We are re-examining all our ethnographical data so as to understand better the role of this experience and the way in which it can be formulated to enhance older people interaction with e-mail systems and other ICT. Second, ethnographic methods should be an input to the design of better interactive experiences. We aim to deepen our research in order to understand how e-mail interfaces could be designed in order to support and enrich the experiences that have emerged from our study. Third, we also intend to combine our findings with some the analysis of some controlled experiments we have done and are currently undertaking in order to ascertain better the impact on interaction of the accessibility barriers we have identified. This will help us inform the design of novel and better e-mail systems for older adults.

i) Acknowlegments

Arroyo for useful discussions and Dai Griffiths who helped us improve our English and our ideas.

j) References

Andersen, R., 1994. Representations and Requirements: The Value of Ethnography in System Design. Human-Computer interaction, 9, 151-182.

Antonucci, T.C., 2001. Social Relations: An Examination of Social Networks, Social Support, and Sense of Control, in: Birren, J.E. and Schaie, K.W. (Eds.), Handbook of the Psychology of Aging, Academic Press, pp: 427-453.

Arnott, J.L., Khairulla, Z., Dickinson, A., Syme, A., Alm, N., Eisma, R. and Gregor, P., 2004. E-mail Interfaces for Older People, in IEEE International Conference on Systems, Man and Cybernetics, The Hague, 111-118.

Baecker, Booth, S., Jovicic, J. and Moore, G., 2000. Reducing the Gap Between What Users Know and What They Need to Know, ACM Conference on Universal Usability, New York, 17-23.

Bannon, L.J., 2000. From Human Factors to Human Actors: The Role of Psychology and Human-Computer Interaction Studies in System Design, in: Baecker, R.M., Grudin, J., Buxton, W.A.S. and Greenberg, S., (Eds.), Reading's in Human Computer Interaction: Toward the year 2000, Morgan Kauffman Publishers, San Francisco (California), pp: 205-214.

Beyer, H. and Holtzblatt, K., 1998. Contextual design: defining customer-centered systems. Morgan Kauffmann Publishers, USA.

Birren, J.E. and Schroots, J.J.F., 2001. The History of Geropsychology, in: Birren, J.E. and Schaie, K.W.(Eds.), Handbook of the Psychology of Aging, Academic Press, San Diego CCalifornia), pp: 1-26.

Blentley, R., Hughes, J., Randall, D., Rodden, T., Sawyer, P., Shapiro, D. and Sommerville, I., 1992. Ethnographically-informed systems design for air traffic control, in CSCW 92, 123-129.

Blomberg, J., Burrell, M. and Guest, G., 2003. An ethnographic Approach to Design, in: Jacko, J.A. and Sears, A. (Eds.), The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, Lawrence Erlbaum Associates, London, pp: 964-987.

Bødker, S., 2006. When Second Wave HCI meets Third Wave Challenges, in NordiCHI, Olso (Norway), 1-7.

Boneva, B. and Kraut, R., 2002. Email, Gender and Personal Relationships, in: Wellman, B. And Haythornthwaite, C. (Eds.), The Internet in Everyday Life, Blackwell Publishing, pp: 372-404.

Button, G., 2000. The ethnographic tradition and design. Design Studies, 21, 319-332.

Carstensen, L. L., 1991. Socioemotional activity theory: Social activity in life-span context. Annual Review of Gerontology and Geriatrics, 11, 195-217

Castells, M. and Tubella, I., 2002. La Societat xarxa a Catalunya, Internet Interdisciplinary Institute (IN3 -UOC) – Catalan report.

Charmaz, K. and Mitchell, R.G., 2007. Grounded Theory in Ethnography, in: Atkinson, P., Coffey, A., Delamont, S., Lofland, J. and Lofland, L. (Eds.), Handbook of Ethnography, SAGE Publications, London, pp: 160-175.

Clarkson, J., Coleman, R., Keates, S. and Lebbon, C., 2003. Inclusive Design: Design for the whole population. Springer.

Cockton, G., 2008. Working spheres or engagements: Implications for designing? Interacting with Computers, 20, 279-286.

Connidis, I.A., 2001. Family Ties & Aging. SAGE Publications, United States of America.

Cooper, A., 2006. The Inmates are Running the Asylum: Why High Tech Products Drive us Crazy and How to Restore the Sanity. Sams Publishing, USA.

Dewalt, K.M., Dewalt, B.R. and Wayland, C.B., 2000. Participant Observation, in: Bernard, H.R. (Ed.), Handbook of Methods in Cultural Anthropology, AltaMira Press, California, pp: 259-301.

Dewsbury, G., Rouncefield, M., Sommerville, I., Onditi, V. and Bagnall, P., 2007. Designing technology with older people. Universal Access in Information Society, 6, 207-217.

Dickinson, A. and Gregor, P., 2006. Computer use has no demonstrated impact on the well-being of older adults. International Journal of Human-Computer Studies, 64, 744-753.

Dickinson, A., Arnott, J.L. and Prior, S., 2007. Methods for human-computer interaction research with older people. Behaviour & Information Technology, 26 (4), 343-352.

Dickinson, A., Newell, A.F., Smith, M.J. and Hill, R.L., 2005. Introducing the Internet to the over-60s: Developing an e-mail system for older novice computer users. Interacting with Computers, 1-22.

Dickinson, A., Smith, M.J., Arnott, J.L., Newell, A.F. and Hill, R.L., 2007. Approaches to Web Search and Navigation for Older Computer Novices, in CHI 2007, (San Jose, California), 281-290.

Dourish, P., 2006. Implications for Design, in CHI, Montréal (Québec, Canada), 541-550.

Elaluf-Calderwood, S., Sørensen, C., 2006. Organizational Agility with Mobile ICT? The Case of London Black Cab Work. Butterworth-Heinemann.

Eronen, L. Five., 2006. Qualitative research methods to make iTV applications universally accessible. Universal Access in Information Society, 5, 219-238.

Fisk, A.D., Rogers, W.A., Charness, N., Czaja, S.J. and Sharit, J., 2004. Designing for older adults. Principles and Creative Human Factors Approaches. CRC Press.

Flecha, R., 2000. Sharing Words. Theory and practice of dialogic learning. Rosman & Littlefield Publications, Maryland.

Gaver, B., Dunne, T. and Pacenti, E., 1999. Cultural Probes, interactions, 21-29.

Glaser, B.G. and Strauss, A.L., 2006. The discovery of grounded theory: strategies for qualitative research. Aldine Transaction, New Jersey.

Hawthorn, D., 2000. Possible implications of aging for interface designers. Interacting with Computers, 12, 507–528.

Hawthorn, D., 2003. How Universal is Good Design for Older Users? in ACM SIGCAPH Computers and the Physically Handicapped, Proceedings of the 2003 ACM Conference on Universal Usability, Vancouver (British Columbia, Canada), 38-46.

Hughes, J., King, V., Rodden, T. and Andersen, H., 1995. The Role of Ethnography in Interactive Systems Design interactions, 2, 57-65.

Hughes, J., King, V., Rodden, T. and Andersen, H., 1994. Moving Out from the Control Room: Ethnography in System Design, in ACM conference on Computer Supported Cooperative Work, Chapel Hill (North Carolina, United States), 429 - 439.

Kanayama, T., 2003. Ethnographic Research on the Experience of Japanese Elderly People Online. New Media & Society, 3, 267-288

Kasesniemi and Rautiainen, P., 2002. Mobile culture of children and teenagers, in: Katz, J.E. and Aakhus, M. (Eds.), Perpetual Contact: Mobile Communication, Private Talk, Public Performance, Cambridge University Press, Cambridge.

Krause, N., 2006. Social Relationships in Late Life, in: Binstock, R. and George, L.K. (Eds.), Handbook of Aging and the Social Sciences, Academic Press, pp: 182-198.

Kurniawan, S.H., 2008. Ageing, in: Harper, S. and Yesilada, Y. (Eds.), Web Accessibility. A Foundation for Research, Springer, pp: 47-61.

Lansdale, D., 2002. Touching Lives: Opening Doors for elders in Retirement Communities Through E-mail and the Internet, in: Morrell, R.W. (Ed.), Older Adults, Health Information, and the World Wide Web, Lawrence Erlbaum Associates, London, pp: 133-153.

Informe 2004. Las Personas Mayores en España. Datos Estadísticos Estatales y por Comunidades Autónomas. Instituto de Mayores y Servicios Sociales (IMSERSO). Ministerio de Trabajo y Asuntos Sociales. Madrid, Spain (Spanish oficial report edited by the Ministry of Work and Social Affairs)

Lines, L. and Home, K.S., 2004. Eliciting user requirements with older adults: lessons from the desig of an interactive domestic alarm system. Universal Access in Information Society, 3, 141-148.

Llobera, J.R., 2003. Invitation to Anthropology: The Structure, Evolution and Cultural Identity of Human Societies. Berghahn Books.

Macaulay, C., Benyon, D. and Crerar, A., 2000. Ethnography, theory and systems design: from intuition to insight. International Journal of Human-Computer Interaction, 53, 35-60.

Mayhorn, C.B., Stronge, A.J., McLaughlin, A.C. and Rogers, W.A., 2004. Older adults, computer training, and the systems approach: a formula for success. Educational Gerontology, 30, 185-203.

McCarthy, J. and Wright, P., 2004. Technology as Experience. The MIT Press, Cambridge, Massachusetts.

Mitchell, V., Nicolle, C., Maguire, M. and Boyle, H., 2007. Web-based interactive TV services for older users. Gerontechjournal, 6 (1), 20-32.

Moggridge, B., 2007. Designing Interactions. The MIT Press, Massachusetts.

Newell, A. F., 2008. Accessible Computing – Past Trends and Future Suggestions. ACM Transactions on Accessible Computing, 1 (2), 9 – 15.

Newell, A.F., Dickinson, A., Smith, M.J. and Gregor, P., 2006. Designing a Portal for Older Users: A Case study of an Industrial/Academic Collaboration. ACM Transactions on Computer-Human Interaction, 13 (3), 347-375.

Nichols, T., Rogers, W. and Fisk, A.D., 2006. Design for Aging, in: Salvendy, G. (Ed.), Handbook of Human Factors and Ergonomics, John Wilely & Sons, New Jersey, pp: 1418-1446.

Nussbaum, J.F., Pecchioni, L.L., Robinson, J.D. and Thompson, T.L., 2000. Communication and Aging. Lawrence Erlbaum Associates.

O'Brien, J., Rodden, T., Rouncefield, M., and Hughes, J., 1999. At home with the technology: an ethnographic study of a set-top-box trial. ACM Transactions on Computer-Human Interaction. 6, 3, 82-308.

Quadrello, T., Hurme, H., Menzinger, J., Smith, P.K., Veisson, M., Vidal, S. and Westerback, S., 2005. Grandparents use of new communication technologies in a European perspective. European Journal of Ageing, 2, 200-207.

Randall, D., Harper, R. and Rouncefield, M., 2007. Fieldwork for Design. Theory and Practice. Springer, London.

Reed, D.J. and Monk, A.F., 2004. Using familiar technologies in unfamiliar ways and learning from the old about the new. Universal Access in Information Society, 3, 114-121.

Robinson, J.D., Skill, T., Turner, J.W., 2004. Media Usage Patterns and Portrayals of Seniors, in Nussbaum, J.F. and Coupland, J.,

(Eds.), Handbook of Communication and Aging Research. Lawrence Erlbaum Associates, New Jersey, pp: 423 – 451

Rodriguez, M.D., Gonzalez, V.M., Favela, J. and Santana, P.C., (in press) Home-based communication system for older adults and their remote family. Computers in Human Behavior.

Rogers, Y., Sharp, H. and Preece, J., 2002. Interaction design: beyond human-computer interaction. John Wiley & Sons.

Sayago, S. and Blat, J., 2008. Exploring the Role of Time and Errors in Real-Life Usability for Older People and ICT, in. Miesenberger, K., Klaus, J., Zagler, W. and Karshmer, A. (Eds.), Computers Helping People with Special Needs. 11th International Conference ICCHP, Lecture Notes in Computer Science. Springer, Linz (Austria), pp: 46-54.

Sayago, Sergio; Blat, Josep. About the relevance of accessibility barriers in the everyday interactions of older people with the web. International Cross-disciplinary Conference on Web Accessibility (W4A-ACM), pp: 104-113, April 20-21, Madrid (Spain). Best Paper Award. ACM ISBN: 978-1-605558-561-1.

Schaie, K. W., Boron, B. J., Willis, S. L., 2005. Everyday Competence in Older Adults, in: Johnson, M. L. (Eds), The Cambridge Handbook of Age and Ageing, Cambridge University Press, Cambridge, pp: 216- 229

Selwyn, N., Gorard, S., Furlong, J. and Madden, L., 2003. Older adults' use of information and communication technology in everyday life. Ageing & Society, 23, 561-582.

Shneiderman, B., 2002. Leonardo's laptop. Human needs and the new computing technologies. The MITPress, Cambridge, Massachusetts.

Suchman, L.A., 1983. Office Procedure as Practical Action: Models of Work and System Design. ACM Transactions on Office Information Systems, 1 (4), 320-328.

Zajicek, M., 2004. A methodology for interface design for older adults, in Sixth International Conference on Enterprise Information Systems ICEIS. Oporto (Portugal), 81-88

Zajicek, M., 2006. Aspects of HCI research for older people. Universal Access in Information Society, 5, 279-286.

K) Appendix A. Ethnographical implementation

See Table 4 in Section 5.1)

l) Appendix B. Ethnographical pictures

Figure 31: E-mailing is an individual activity? Photo related to section d.1.5

Figure 32: Too much space for my e-mails. Photo related to d.1.2) and e.1)
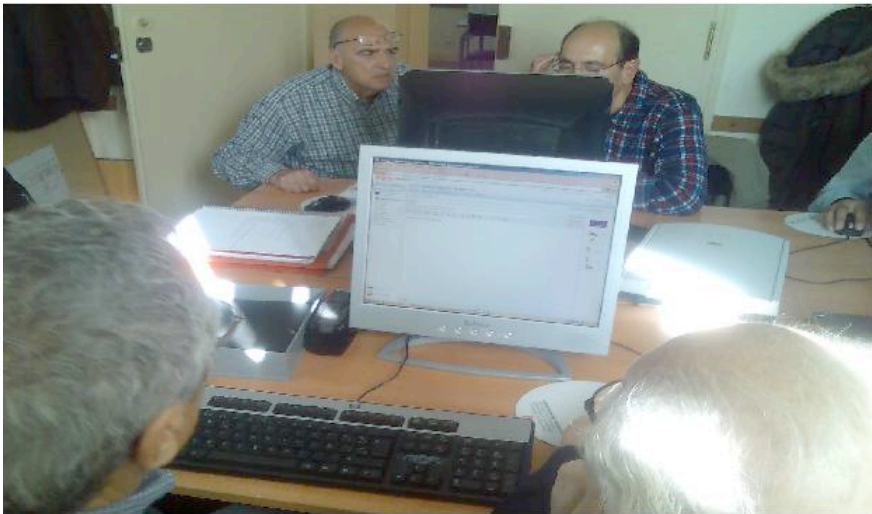
Figure 33: E-mailing in pairs; wearing reading glasses rather than making things bigger and failing to remember steps. Photo related to d.1.5) and e.5)

Figure 34: My memory in my notes; words and no icons. Photo related to e.3) and e.6)

Figure 35: The joys of ICT (and e-mailing). Photo related to d.1.5)

Figure 36: E-mailing alone at home? Photo related to d.1.1), d.1.4), e.3) and d.1.5)

Figure 37: This is indepence. Photo related to e.3)

6. CONCLUSIONS

This dissertation has explored the use that older people make of ICT in their lives and their interaction with a wide range of interfaces and technologies in naturally occurring settings. A variety of research techniques and methods have been employed. The major contribution of this dissertation to HCI with older people is a research paradigm that goes beyond the current one: *from older people considered as a set of factors to interaction based on older people considered as social actors.*

This contribution towards shifting the research focus has been made in two main aspects. In terms of use, socialisation, independence, inclusion and life experience are key aspects that determine largely the way in which older people make use of ICT in their daily lives. In terms of interaction, compensation for age-related changes in functional abilities should not be understood in isolation. Evidence has been given in a number of areas, such as the adaptation of methods and interaction measures; the impact of the concept of life experience in interaction, methods and training; the relevance of cognition over vision in interaction with both small and normal-sized interfaces, and recommendations in guidelines. The research on interaction must be centred on real use rather than mostly (or most frequently solely) based on lab experiments.

Let us discuss further the conclusions of this thesis, its limitations and some areas of future research.

6.1   Discussing the conclusions in a broader sense

The paradigm proposed in this dissertation is a distinct and original contribution. Within the current research scenario, which has been reviewed in the several papers presented earlier, declines in major life functions have a glaringly obvious impact on interactions. However, this scenario puts older people out of their context. Not only is this context physical, but also social (e.g. grandchildren, children and close friends) and individual (e.g. life experience). This need to shift and widen the research paradigm provides a different perspective into current research and has resulted in a number of publications, as well as being supported by a number of

studies covering different areas and carried out in several settings. Moreover, the turn to the social and practice suggested by this dissertation is in line with current trends in HCI [1], which as been overlooked in HCI with older people.

The techniques and methods employed along the PhD period cover a wide range of scientific tools, from tests of significance to Grounded Theory methods. There have also been specific contributions to methods, as well as the novel use of classifical ethnography ([6], [12]) for researching with older people, which is relatively new in this domain. This variety and selection of techniques, and methodological contributions, gives strong support to the findings.

This dissertation has adopted and adapted concepts and approaches from several disciplines to advance understanding of HCI with older people. As for disciplines, studies of ageing (psychology, cognition and social aspects), ethnography and HCI (with and without disabled people) are areas which have a contribution to this thesis. The ethnographical study was conducted by following a classical ethnographical approach in Anthropology. The concept of life experience is taken from Life Course research on ageing and inclusion from Inclusive Design [3]. This appreciation of the relationship between the special theme of the dissertation and the wider field of knowledge is an indicator that the results are grounded in a more comprehensive theoretical body.

Having discussed the conclusions, there are clear reasons to think that whereas they seriously challenge current research, they have a solid scientific basis. On the other hand, this dissertation does not claim that the work presented here is free of limitations. The most relevant ones that we see now are discussed below.

6.2 Limitations

It might not be possible to extrapolate the results to other cultural contexts; much more ethnographical research in other contexts is probably needed. Nevertheless, the evidence obtained in different studies and the profile of participants makes the contribution relevant for a representative and a growing sector of current

population: ordinary people over the age of 60 that are making use of ICT in their lives.

The ethnographical insights might have been interpreted in different ways; one should be aware of this potential bias. Nevertheless, combining traditional fieldwork with experimentations, discussion with colleagues and the relationship with research done in other areas give strong support to the contributions. It also reinforces the ethnographical approach adopted, as well as showing its value in HCI with older people.

No proof-of-concept system shows the applicability of the paradigm proposed. Nevertheless, some specific implications for design discussed in some of the papers presented in earlier chapters, the insights provided in form of stories told in first person by older users, and the web site with photos which resoinds with the Personas techniques should be a first step towards helping interaction designers to create better technologies; other material created[51] for this thesis should help too.

Even with these caveats, the contribution made by this dissertation suggests that richer models of HCI are required if we are to develop research with social actors rather than factors. The following section gives an overall description of possible approaches that will take HCI with older people beyond its current state of the art.

6.3   Beyond HCI with older people

Shifting the focus from factors to social actors entails widening the view of interactions. To date, HCI with older people takes a static picture of interactions. They are mostly seen through the lens of what is happening in a very particular period of time (i.e. a lab interaction session). Nevertheless, the relevance of life experience suggests that future research should look at the history of interactions, as well as the present ones.

Broadening the focus of interaction also requires considering new concepts and the likely relationship amongst them. The life experience of a person is shaped by his or her historical, cultural,

---

[51] http://www.tecn.upf.edu/~ssayag/thesis

sociological and individual context. Other interaction variables will come about as a result of exploring the life experience of an older individual.

Another implication of shifting the research focus is the need to turn to real life settings. More ethnographical research will be required. The chief reason is that other methods do not allow us to render visible real-life interactions and understand them. Nevertheless, this dissertation suggests that this ethnographical approach could be a combination of classical fieldwork, asking about the present and the past, and experimentation. Observing and talking with older people is not enough in order to comprehend the impact of the reality of interactions on specific technologies and interfaces. Experimentations need to be conducted at the same time as the ethnographical work is being carried out.

These approaches "beyond HCI with older people" open up a wide range of research lines and opportunities. The author expects to work on and explore some of them in the future. They are outlined in the following section.

6.4   Future work

We expect to use techniques from Life Course research on ageing in order to attain a better insight into the impact of life experience in HCI with older people. Another research line corresponds to interactive experiences. What elements give rise to experiences in ageing with ICT and how to analyse and support them in existing and novel interfaces will represent the bulk of our work in the near future. Both areas will probably require deeper investigation, and, at the same time, re-examining and gathering more ethnographical data. This will be done through experimental ethnography, which is also expected to help the community understand better the interactions that older people make with ICT and, at the same time, how to do research with them.

This section has been described in a somewhat high-level of abstraction because, at best, this dissertation has made the strange familiar. There are more to older people than meets the eye. In suggesting a change in the view of older people as computer users, this dissertation has hopefully brought to light a series of aspects

that have received scant attention so far and hopefully, provoke reflection on them and future research. It remains to be seen what will emerge "from factors to social actors" in the future.

7. REFERENCES

[1].   Bodker, S., 2006. When Second Wave HCI meets Third Wave Challenges. NordiCHI, (Olso, Norway), pp: 1-7.

[2].   Charmaz, K. and Mitchell, R.G., 2007. Grounded Theory in Ethnography, in Atkinson, P., Coffey, A., Delamont, S., Lofland, J. and Lofland, L. (Eds.) Handbook of Ethnography, SAGE Publications, London, pp: 160-175.

[3].   Clarkson, J., Coleman, R., Keates, S. and Lebbon, C. (Eds.), 2003. Inclusive Design: Design for the whole population. Springer.

[4].   Czaja, S.J. (Ed.), 1990. Human Factors Research Needs for an Aging Population. National Academy Press, Washington, D.C.

[5].   Dickinson, A., Arnott, J.L., Prior, S., 2007. Methods for human-computer interaction research with older people. Behaviour & Information Technology, 26 (4), pp: 343-352.

[6].   Dourish, P., 2006. Implications for Design. ACM-CHI, Montréal (Québec, Canada), pp: 541-550.

[7].   Hawthorn, D., 2000. Possible implications of aging for interface designers. Interacting with Computers, 12, pp: 507–528.

[8].   Kasesniemi and Rautiainen, P., 2002. Mobile culture of children and teenagers, in: Katz, J.E. and Aakhus, M. (Eds.), Perpectual Contact: Mobile Communication, Private Talk, Public Performance, Cambridge University Press, Cambridge.

[9].   Newell, A.F., 2008. Accessible Computing - Past Trends and Future Suggestions. ACM Transactions on Accessible Computing, 1 (2), 7 pages.

[10].   Newell, A.F., Dickinson, A., Smith, M.J. and Gregor, P, 2006. Designing a Portal for Older Users: A Case study of an Industrial/Academic Collaboration. ACM Transactions on Computer-Human Interaction, 13 (3), pp: 347-375.

[11]. Paciello, M.G., 2000. Web accessibility for people with disabilities. CMP books, Kansas.

[12]. Randall, D., Harper, R. and Rouncefield, M., 2007. Fieldwork for Design. Theory and Practice. Springer, London.

[13]. Sayago, S., 2006. Some aspects of ICT accessibility for the young elderly. MPhil in Computer Science and Digitial Communication, supervised by Prof. Josep Blat. Department of Information and Communication Technologies, Universitat Pompeu Fabra (Barcelona, Spain).

[14]. Sayago, S., Blat, J., 2009. About the relevance of accessibility barriers in the everyday interactions of older people with the web. International Cross-disciplinary Conference on Web Accessibility (W4A-ACM), pp: 104-113, April 20-21, Madrid (Spain). Best Paper Award. ACM ISBN: 978-1-605558-561-1

[15]. Sayago, S., Blat, J., 2009. Life experience and socialisation in some HCI methods with older people. Accepted for publication in *CHINZ'09,* July 6-7, 2009, Auckland, New Zealand. ACM 978-1-60558-574-1.

[16]. Sayago, S., Blat, J., 2009. Telling the story of older people e-mailing. International Journal of Human-Computer Studies. Revision sent after first provisional acceptance.

[17]. Sayago, S., Blat, J., 2008. How relevant is selective attention in the design of online forms for older people? Workshop on Cognition and the Web 2008: Information Processing, Comprehension and Learning. Granada, Spain. April 24th-26th, pp:101-109

[18]. Sayago, S., Blat, J., 2008. Exploring the role of time and errors in real-life usability for older people and ICT. in Miesenberger, K., Klaus, J., Zagler, W. and Karshmer, A. (Eds.), Computers Helping People with Special Needs. Lecture Notes in Computer Science, Springer, pp: 46-54

[19]. Sayago, S., Blat, J., 2006. Adapting an online website to a Palm OS with young elderly people. IADIS International conference WWW/Internet 2006, Murcia (Spain). pp: 115-119, ISBN: 972-8924-19-4. Edited by: Pedro Isaías, Miguel Baptista Nunes and Inmaculada J. Martínez

[20]. Sayago, S., Camacho, L., Blat, J., 2009. Evaluation of techniques defined in WCAG 2.0 with older people. International Cross-disciplinary Conference on Web Accessibility (W4A-ACM), pp: 79-82, April 20-21, Madrid (Spain). ACM ISBN: 978-1-605558-561-1.

[21]. Sayago, S., Santos, P., Arenas, M., Gonzalez, M., 2008.: Meeting some educational needs of elderly people in ICT: Two exploratory case studies. ACM Crossroads, 14.2.

[22]. Settersen, R.A. (Ed.), 2003. Invitation to the Life Course. Toward new Understandings of Later Life. Baywood Publishing Company, New York.

ANNEX I. Research activities surrounding this thesis

1. Older people research complementing the content of this PhD

In addition to the papers presented in the body of this dissertation, a number of papers have also been published in international peer-reviewed conferences, magazines and workshops. They are listed in Section 3. Let us outline the content of the papers related to Chapters 2 to 5.

The papers [16], [17] and [19] draw upon the ethnographical study described in Chapter 5 as well. The first one focuses on intergenerational communication established in older adulthood via e-mail. Different communication patterns between older people and children and grandchildren are described and discussed, while the second provides a classification of what good or bad usability means in real-life interactions and how usability relates to interactive experiences; the third presents some methodological challenges in doing ethnography with older people in ICT, such as the role of the ethnographer and technologies for recording interactions and observations.

The papers [21] and [24] describe and analyse pilot studies which paved the basis for the follow-up experiences presented in Sections 3.1 and 3.3. In the first one, usability tests carried out in an old-age pensioner association in a local town near Barcelona while designing its website revealed that standard asterisks were not helpful for older people to fill in online forms correctly; within the same study, the second presents that it was found that WCAG do not consider carefully enough relevant needs of older people, such as "click here to".

The paper [23] reinforces Section 3.2 by discussing the problems caused by assistive technologies such as the screen magnifier, which is available in the Microsoft Windows operating system. Making system element bigger is not always an accessibility requirement for older people, as opposed to reducing cognitive load.

The paper [22] strengthens the argument made in Section 2.1. Difficulties in running focus groups and thinking-aloud protocols in labs are mostly overcome by conducting focus groups around computers (and not around a table) in naturally occurring settings and thinking-aloud protocols in pairs, which reflect real-life practices.

The papers [18] and [20] are quantitative studies of the accessibility of online searching strategies and word-processing functionalities. In the first one, ANOVA tests similar to the one carried out in Section 3.1 were conducted in order to analyse the performance of older people in searching online information by using Google, Advanced Google and Yahoo! directory. The results showed that searching by writing allows older people to find more information than searching by clicking on links, which reinforces the argument made in Section 5.1, where difficulties using the mouse indicated to be important. The second uses the Pearson-moment correlation coefficient in some tests in order to identify which of the following accessibility factors (difficulties using the mouse, remembering the steps and understanding the terminology) was more correlated to the overall usability of word-processing functionalities. The results showed that steps remembering and using the mouse played a much more important role in usability than terminology.

Another activity related to HCI with older people has been the supervision of degree projects within the studies of Computer Science at Universitat Pompeu Fabra. The results of these research projects corroborate some of the findings presented in this dissertation. The references of these projects are listed in Section 3. Their relationship with this dissertation is summarised below.

Project [1] shows that terminology is more important than icons in designing the user interface of a YouTube for seniors. This result concurs with the ones presented in Chapter 5. This project also shows that questionnaires are very difficult to carry out, whereas using them as the script of interviews (mainly, in focus groups) turned out to be a more useful and effective way of recruiting older people and make them participate in the research. This finding resonates with Chapter 2. This study was carried out with 11 older people in an old-age pensioner association in Barcelona (Club Sant Jordi-Barcelona Verneda).

Projects [2] and [13] point out that the size of visual elements is nowhere near as important as reducing the precision using the mouse and providing a navigational strategy that minimized the cognitive load (number of steps) in designing web sites for older people. These findings concur with those presented in Chapter 5. These studies were carried out with 15 older people in an old-age pensioner association and in an adult centre in Barcelona (Joan Casanelles, Punt Multimedia).

Project [12] shows that searching by writing (querying) allows older people to find more online information than searching by clicking in a given period of time. This finding concurs with paper [18] outlined in Section 1. This study was carried out with 15 older people in an adult centre (Obra Social de la Caixa) in Girona (Catalonia).

Project [9] shows that enlarging the size of asterisks or using different types of visual clues do not reduce significantly the number of errors made by older people while filling in online forms. This result concurs with Section 3.1. This study was carried out with 15 older people in an old-age pensioner association (Casal d'avis de l'Hospitalet) in Hospitalet (near Barcelona).

2. Supporting evaluation in RTD projects in diverse areas

During the period of this thesis the author has been working on the evaluation of a wide range of emerging media technologies in several areas. Examples are digital cinema, subtitling, information retrieval, audiovisual entertainment and eLearning. These evaluation activities have been carried out within the framework of R&D projects[52] , where the author has been the evaluation co-ordinator or playing a supporting role. The co-ordinator role entailed:

- Establishing a common evaluation methodology in each individual project

---

[52] The vast majority of them were partially funded by the EU

- Understanding the needs of both the project and end-users

- Coordinating with industry, user-groups and research partners

- Reporting evaluation activities in formal documents (deliverable reports)

- Participating in project meetings and EU reviews

The list of projects with their corresponding areas is presented in Table 6.

Project Name	Web	Area
SALERO: Semantic Audiovisual Entertainment Reusable Objects	http://www.salero.info/	Audiovisual Entertainment
SEMEDIA: Searching for Media	http://www.semedia.org/	Multimedia information retrieval
IP-RACINE: Integrated Project Research Area Cine	http://www.ipracine.org/	Digital cinema
UNFOLD: Understanding New Forms of Learning Design	http://www.unfold-project.org	eLearning and standards
eTitle	http://www.etitle.co.uk	Automatic subtitling
SpeedFX: Very high-resolution real-time graphic interaction for the media industries	http://gti.upf.edu/speedfx/	Post-production in digital cinema
SCOPE: Structuring Content for On-line Publishing Environments	http://gti.upf.edu/scope	eLearning

Table 6: List of RTD projects

As a result of this involvement in projects, I have been the co-author (in some case, main author) of a number of papers whose full list is presented later and summarised next.

Paper [26] describes the design and evaluation of QAed, a simple authoring tool for managing tests based on IMS-QTI Lite (an IMS Specification), which I led and paved the basis for papers [4] and [5], where limitations of eLearning standards are discussed. The work done on evaluation in the UNFOLD project was also published in a booklet [15]. In papers [6], [7], [8], [10] and [14], I

played a supporting role. In [10] and [14], my experience with dialogic learning helped to inform the development of a novel IMS LD template to support this type of learning. Papers [6], [7], [8] make references to the work on evaluation in eLearning.

In addition to papers on eLearning, the evaluation activities carried out in SEMEDIA helped to guide the development of a novel methodology to generate user interfaces based on specific parameters presented in [11]. I also contributed to the design and evaluation of tool to generate user interfaces based on UIML (Unified Interface Mark-up Language) [3].

Finally, I have been teaching on human-computer interaction to undergraduate students since 2006 in a second year's subject within the studies of Computer Science at Universitat Pompeu Fabra. I led the paper [25], which was published in a Spanish workshop on HCI education.

3. References

[1]. Arias, J., 2008. Design and evaluation of the user interface of a video browser for older people. MSc in Computer Science, supervised by Sergio Sayago. Universitat Pompeu Fabra

[2]. Camacho, L., 2006. Design and evaluation of a simple web site for older people. MSc in Computer Science, supervised by Sergio Sayago. Universitat Pompeu Fabra

[3]. Casado, F., Navarrete, T., Sayago, S., Blat, J., 2005. Una herramienta para la creación de interfaces multiplataformas utilizando UIML. Proceedings on the VI Congreso de Interacción Persona Ordenador (INTERACCIÓN' 2005). Edited by: Ángel R. Puerta, Miguel Gea. Granada, Spain. ISBN: 84-9732-436-6, pp: 181-189.

[4]. García, R., Blat, J., Griffiths, D., Sayago, S., Martínez, J., Casado, F., 2004. Limitations of some eLearning standards for supporting learning. International Conference of Interactive Computer-Aided Learning, ICL 2004 (in cooperation with ACM-Austrian Chapter, and supported by IEEE Education Society), Villach (Austria), ISBN: 3-89958-089-3

[5]. García, R., Blat, J., Sayago, S., Griffiths, D., Casado, F., Martinez, J., 2004. Supporting Usability and Reusability Based on eLearning Standards. ICALT 2004, 30 August - 1 September, Joensuu, Finland. ISBN: 0-7695-2181-9

[6]. Griffiths, D., Blat, J., Casado, F., Garcia, R., Martinez, J., Sayago, S., 2005. Challenges in the wider adoption of Learning Design: Two exploratory case studies. in Koper, R. and Tattersall, C. eds. Learning Design: a handbook on Modelling and Delivering Networked Education and training, Springer, pp: 327-339.

[7]. Griffiths, D.; Blat, J.; Garcia, R.; Sayago, S., 2005. The contribution of IMS Learning Design to the creation of reusable learning resources. RED (Revista de Educación a Distancia). Año IV. Número monográfico V – October, 18th.

[8]. Griffiths, D., Blat, J., Garcia, R., Sayago, S., 2004. La aportación de IMS Learning Design a la creación de recursos pedagógicos reutilizables. I Simposio Pluridisciplinar sobre Diseño, Evaluación y Descripción de Contenidos Educativos Reutilizables. Guadalajara (Spain), October 20-22.

[9]. Guijarro, J.M., 2008. Some aspects of designing online forms for the elderly, MSc in Computer Science, supervised by Sergio Sayago. Universitat Pompeu Fabra

[10]. Hernández-Leo, D., Pérez-Sanagustin, M., Santos, P., Sayago, S., Griffiths, D., Blat, J., 2008. Dialogic learning and interactive groups: an IMS LD template integrated in runtime systems, Proceedings TENCompetence Open Workshop in Madrid, Spain, April. 10th-11th. Available at http://dspace.ou.nl/handle/1820/1213

[11]. Moghnieh, A., Sayago, S., Arroyo, E., Copi, G., Blat, J., 2009. Parameterized User-Centered Design for Interacting with Multimedia Repositories. Proceedings of The First International Conference on Advances in Multimedia, Mmedia 2009. July 20-25. Colmar, France

[12].   Morales, J., 2008. Usability study of two techniques for searching online information with older people. MSc in Computer Science, supervised by Sergio Sayago. Universitat Pompeu Fabra

[13].   Palau, X., 2006. Design and evaluation of an accessible website targeted at the elderly. MSc in Computer Science, supervised by Sergio Sayago. Universitat Pompeu Fabra

[14].   Pérez-Sanagustín, M., Hernández-Leo, D., Santos, P., Sayago, S., Blat, J., Griffiths, D., 2009. Dialogic learning and interactive groups: an IMS LD template integrated in runtime systems. International Journal of Emerging Technologies in Learning (3), pp: 38-45.

[15].   Sayago, S., 2006. Participation in UNFOLD. In Burgos, D. and Griffiths, D. eds. The UNFOLD project. Understanding and Using Learning Design. Open University of The Netherlands, Heerlen Educational Technology Expertise Centre, pp: 53-59. ISBN: 90 358 233 70.

[16].   Sayago, S., Blat, J., 2009. Some aspects of intergenerational communication established in older adulthood via email. CHI 2009 Workshop Age matters: Bridging the generation gap through technology-mediated interaction. Boston, April.

[17].   Sayago, S., Blat, J., 2009. Understanding Usability in Context for Older People and its Relationship with their Everyday Interaction Experiences. Accepted for publishing. HCI International 2009, thematic area Universal Access in Human-Computer Interaction. Edited by Constantine Stephanidis. Lecture Notes in Computer Science, San Diego, California, USA.

[18].   Sayago, S., Blat, J., 2008. A preliminary usability evaluation of three strategies for seeking online information with elderly people. in the Proceedings of the International Cross-Disciplinary Workshop on Web Accessibility (W4A-ACM), co-located with the 16th International World Wide Web Conference. May 07-08, Canada. pp: 54 - 57. ISBN: 1-59593-590-X.

[19]. Sayago, S., Blat, J., 2008. Some lessons learned from doing social interaction design in ICT with older people. SOCIOTECH-ID 2008, London, 30th May. http://iit.tvu.ac.uk/sociotech-id08

[20]. Sayago, S., Blat, J., 2007. An initial usability evaluation of some word-processing tasks with the elderly. In the Proceedings of the 9th International Conference on Information Systems (ICEIS). Edited by Jorge Cardoso, José Cordeiro and Joaquim Filipe. ISBN: 978-972-8865-92-4. Funchal, Portugal, June 12-16, 2007. pp: 323-328

[21]. Sayago, S., Blat, J., 2007. Some aspects of designing accessible online forms for the young elderly, in WEBIST (Third International Conference on Web Information Systems and Technologies). Barcelona, Spain. March 3-6. INSTICC Press. ISBN: 978-972-8865-78-8, pp: 13-18.

[22]. Sayago, S., Blat, J., 2006. Conducting thinking-aloud tests and focus groups with the young elderly. Workshop on HCI, the Web and the Older population, within British HCI 2006. Queen Mary University, London, UK. pp: 23-25. Edited by: Joy Goodman, Anna Dickinson, Suzette Keith and Gill Whitney

[23]. Sayago, S., Blat, J., 2004. About the accessibility of PDAs and some accessibility technologies for the elderly. Convivio web-zine. First issue. January, 2004. http://webzine.convivionetwork.net/

[24]. Sayago, S., Blat, J., 2004. Evaluación preliminar de las WCAG 1.0 basada en el diseño de un sitio web accesible para personas de la tercera edad. I Jornadas de Accesibilidad y Nuevas Tecnologias (JANT - workshop on accessibility and ICT), Universitat de Deusto, Basque Country (Spain)

[25]. Sayago, S., Blat, J., Berbegal, N., 2005 Introducción a la ingenería del software: Diseño de interfaces. I Jornadas de Trabajo sobre Enseñanza de CHI Puertollano, July, 4-8, pp: 105-113. ISBN: 84-689-2758-9

[26]. Sayago, S., Martínez, J., Blat, J., García, R., Griffiths, D., Casado, F., 2006. Design and evaluation of a simple eLearning

authoring tool, in Navarro, R. and Lorés, J. eds. HCI related papers of Interacción 2004. Springer, pp: 81-89. ISBN: 1-4020-4204-3