International Journal of Emerging Technologies and Society
Vol. 8, No. 2, 2010, pp: 99 – 113

Websites for Seniors: Cognitive Accessibility

Oliver K. Burmeister is a member of the Centre for Research in Complex Systems, School of Computing and Mathematics, Charles Sturt University, Australia

Abstract

Few studies have examined the cognitive challenges faced by seniors in website use, let alone the way designers can mitigate those challenges. The findings of this ethnographic study of an Australian online community for seniors, extends present understanding of cognition and seniors, challenging the assumptions of some previous studies. This study shows that sudden adaptation to complex changes, as opposed to complexity itself, is cognitively challenging for some, particularly older, seniors. The design literature does not distinguish cognitive functions, although there are at least two distinct types of cognition that are recognised in psycho-social theories of ageing. The findings of this study suggest that, greater design effort needs to be devoted to mechanical cognition, to do with information processing and learning, than to pragmatic cognition, which concerns social interaction and communication. In addition to the main finding about adaptation to substantial change, two other cognitive considerations affecting website access for seniors were found to be: the importance of a flat navigational structure and that of providing functional, memory aids.

Keywords: Ageing – Human Computer Interaction – Value Sensitive Design

ISSN 1835-8780
http://www.swin.edu.au/ijets

iJETS Vol. 8, No. 2, 2010, pp: 99 – 113

Websites for Seniors: Cognitive Accessibility

Introduction

The cognitive challenges faced by senior users of websites, have not received sufficient attention in the literature. For example, Hanson (2009) claimed that too much focus has been on issues of perceptual accessibility for seniors (vision and hearing), and too little on cognitive declines. Some work has been report, including one study that suggested that the ability of seniors to cope with cognitive tasks varied to some extent on the basis of the prior experiences (Kang & Yoon 2008), and another that reported that issues of cognitive load are particularly important (Sayago & Blat 2010). Other studies have examined cognitive challenges in areas not restricted to websites, including two that examined mobile phone usage (Kurniawan 2008; Ziefle & Bay 2004), one that reported on research methods involving seniors (Barrett & Kirk 2000) and another for which the context was digital TV (Rice & Alm 2008). One of the mobile phone studies (Kurniawan 2008) claimed that seniors cannot, cognitively, cope with complexity. However, the findings of the study reported here suggest that it is not complexity per se, but instead, adapting to complex change, particularly sudden adaptation, that is cognitively challenging to seniors. Furthermore, most previous studies have treated all issues of cognition together, when psycho-social literature on ageing suggests that there are at least two major forms of cognitive ability, that are particularly pertinent to studies of seniors, pragmatic cognition (cultural systems of inheritance, such as verbal knowledge) and mechanical cognition (reasoning, spatial orientation, or perceptual speed) (Baltes, Staudinger & Lindenberger 1999). The argument put forward in this paper is that, a result of the latter has been too great an emphasis on pragmatics, and not enough focus on mechanical cognition, such as assisting seniors to adapt to complex website changes. Studies have identified the need for more research involving the use of technology by seniors (Malta 2007; Pfeil 2010; Xie 2008), with a few discussing issues of cognition, in passing, while focused on other areas of seniors using technology (Joint Academy Initiative on Aging 2010; Pfeil & Zaphiris 2009, Sayago & Blat 2008; Sum et al. 2008).

The paper begins by describing the present study, including the method, sampling, and analysis involved, and a synopsis of the online community of seniors that was the focus of the study. It then goes on to describe the psycho-social theories of ageing that most directly impact the cognitive abilities of seniors when using websites, and in so doing, to describe and distinguish pragmatics and mechanics. Finally, by employing exemplary illustrations from the findings of the present study, the design challenges of mechanical cognition are discussed.

Description of the Study

The present study focused on the early stages of a human computer interaction (HCI) methodology known as value sensitive design (VSD) (Friedman, Kahn & Borning 2006). It is a methodology that complements existing design methodologies. It builds on contextual and participatory design principles to consider the values of users and how technology can better incorporate those values. A fundamental premise of VSD is that technology artifacts embody values. Prior to the present study, the values of seniors had not been considered in VSD studies, nor in the HCI literature more generally. Within the design literature, the way in which user values are discovered, varies (Flanagan, Howe & Nissenbaum 2008). The present study involved a thirty month, ethnographic investigation of Australia's largest online community for seniors, greypath.com.au (GreyPath). The key research question that directed

the study was: *What do participants in an online community for seniors value about their online social interaction and what are the implications for design?*

Ethnography in HCI

Over the past decade ethnographic studies have increasingly become common in HCI studies (Dourish 2006). For example, Sayago and Blat (2010: 3) claimed:

> 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 … and (ii) to provide explanatory frame-works for whatever is observed that offer us new ways of imagining the relationship between people and technology.

The present study followed an interpretivist, constructivist philosophy to help answer the research question. It was a study to discover the values of seniors in a chosen online community and therefore their perceptions of their values were crucial. Given that no prior studies had been reported of seniors' values when using websites, an inductive approach involving observation and in-depth interviews with seniors was seen as appropriate. Interpretivist constructivists emphasise the meanings of participants within the social phenomenon under study (Williamson 2006). This was appropriate to the present study of an online community, because the aim was to understand the 'meanings' of participants with regard to their values. For example, in the study it was important to know how people in the particular social context interpreted social actions such as friendship, respect or trust, where the researcher needed to understand the meanings that constituted the action, that is, the meanings of the people engaged in the social setting (Schwandt 2003).

The study involved an initial period of eleven months, during which community social interaction was observed. This led to an initial categorisation of values that were important to these users. However, to understand those values, the observation was followed by in-depth, semi-structured interviews with thirty participants. This approach sought patterns that emerged from the shared meanings of participants. The thirty interviewees for the study were chosen on the basis of criterion sampling (Patton 2002). Criterion sampling uses a particular set of criteria to guide sample selection. In the present study, the criteria for selection of participants were determined prior to the commencement of the sample selection, in order to aid as widely as possible the understanding of the online community members' social interaction values. The criteria included selection based on age, location, membership type (GreyPath management, volunteer contributors, long-term and novice members), and more. The interviews were up to two hours in duration. Where possible they were conducted face-to-face, although for pragmatic reasons, in order to interview participants from different parts of urban and rural Australia, as well as from outside of Australia, telephone interviews were also employed. All interviews were audio-recorded and then transcribed. Once transcribed, the written version of the interview was returned to the interviewee for further comment.

Context of Data Collection

GreyPath membership is restricted to seniors, which it defines as 50 years of age and over. The community has members in every state and territory of Australia, including some who are travelling (have no fixed address) and overseas members. GreyPath has 35 volunteers who freely give of their time and skills to maintain the site. It has members who rarely use the site and then only to find specific information, and others who use the site for many hours every day, for social interaction with other members. Members can enrol in free or nominal cost courses, and they can contribute to or receive information on a wide variety of topics.

The online destinations of GreyPath members are dictated by their interests and time constraints. GreyPath is also a safe place, in that it is moderated by volunteer contributors.

Data Analysis

Analysis of data was a continuous process, using an inductive approach for thematic analysis. The initial themes and categories, determined both during the observation phase and after the initial interviews, were continually reassessed and expanded as more data was collected. Values that were thus discovered were then structured and organised into themes. This approach followed that of Morse (2008) who claimed that the analytic process for identifying categories and themes begins with the researcher identifying categories. The identification of themes comes at a later stage in the analytic process, employed to tie categories together. They emerge from reflection on the categories that have been identified. This analytic process aids the interpretation of user meanings pertaining to each theme and category.

Of the six themes which thus emerged from the data analysis, one theme, 'site design values', gave rise to accessibility issues involving cognition. Within this theme there were seven key value categories that emerged. These included the *administration of content*, and *content of interest*, which examined content from the perspectives of both administrators and members, respectively. Related to content of interest was the value *variety*. Variety involved the continual small changes that were made, to keep the website lively and of interest to members. Related to *variety* was the value *structure*, and it was in the context of these findings, that most of the results reported here, on the cognitive challenges to seniors, arose. The final three value categories, identified as part of this theme, were the *availability of experts*, *competitions*, and the use of *visual images*.

As stated earlier, the focus of this study was on what GreyPath seniors valued about their online social interaction, and consequently, one might expect values such as *friendship* to be important. How then can *variety* and *structure*, be described as values? Within the philosophical literature there exists an important distinction concerning values, namely extrinsic and intrinsic values. This distinction between extrinsic values and intrinsic values is not evident in the values literature on design, although it is readily found in the philosophical literature. For example, in the Stanford Encyclopedia of Philosophy (Zimmerman 2010) intrinsic values are described as ones that have value in and of themselves, whereas extrinsic values are valued, but are not values in, and of, themselves. Instead such extrinsic values are associated with intrinsic values. In the context of this paper, the values *variety* and *structure* are both extrinsic values. That is, although users described these two values as things which were important to them, they were in reality the means to attaining the intrinsic values that were particularly important to these users. Thus for example, the value *structure* afforded users the opportunity to engage in online social activities, that is, it was valued because it was the means through which something else that was important to these users could be experienced.

Theories of Ageing Involving Cognition

Three theories particularly relevant to cognition and seniors are: selective optimization with compensation (SOC), cognitive reserve and the scaffolding theory of aging and cognition (STAC). SOC researchers (Baltes 1997; Baltes & Smith 2002; Marsiske, Lang & Baltes 1995) found that, from an evolutionary perspective, selection pressures operated in the first half of an individual's lifespan, to ensure reproductive fitness, as well as effective parenting behaviours. According to this theory, progression to successful ageing meant one had to go

beyond reliance on evolutionary biology, to cultural influences. Successful ageing was less a function of biology and more one of increasing the culturally-based resources available to people to help them find supportive compensations for biological losses. SOC is a theory which takes an integrative approach to multiple factors affecting seniors as they age, combining individual, social and institutional perspectives. It describes the selection of areas most important to the individual's personality, so as to focus that person's energy optimally in those areas; it also recognises that people cannot do everything themselves and that they compensate for this by relying on external supports in those areas (Baltes 1997; Marsiske et al. 1995).

The SOC studies in the development of cognitive abilities, show that change in adaptive capacity occurs in two related areas, which are referred to as mechanics and pragmatics. Mechanics describes the biological intellectual functions concerning information processing, such as "reasoning, spatial orientation, or perceptual speed", whilst pragmatics describes the "cultural systems of inheritance", for example "verbal knowledge (e.g. semantic memory) and certain facets of numerical ability" (Baltes et al. 1999: 487). The term 'semantic memory' is employed by cognitive psychologists to refer to a person's store of factual knowledge (Craik 1999). Craik (1999: 84) argued that research had shown that seniors experienced little or no decline in semantic memory performance (pragmatics), but "substantial age-related declines in episodic memory performance… (which) …may be taken as a further proof of the existence of at least two separate memory systems". Craik (1999) also claimed that cognitive aging researchers had demonstrated that episodic memory, also referred to as fluid intelligence, could be aided by providing seniors with supportive contextual information. These psychological categories of fluid and crystallized intelligence, were recently employed in a study of web use by seniors (Hanson 2009). Fluid intelligence is the capacity to think logically and solve problems, independent of acquired knowledge. Crystallized intelligence is the ability to use skills, knowledge, and experience. Although it is not equated with memory, crystallized intelligence does rely on accessing information from long-term memory. Thus, there is support for the distinction of cognition, into mechanics (fluid intelligence, episodic memory), and pragmatics (crystallized intelligence, semantic memory). Unlike mechanical performance, pragmatic abilities are not affected by increasing age, although there is some evidence of decline in the very old (Baltes et al. 1999; Craik 1999). Hence the focus of this paper is on mechanical cognition.

Cognitive reserve is a theory that claims that over the course of the lifespan, individuals can build up a reserve that helps to protect them against impaired cognitive function, even if there are underlying neuropathologies present (Stern 2009). A related theory, STAC, states that, whereas cognitive reserve is concerned with disease, non-disease processes need not decline with age (Park & Reuter-Lorenz 2009: 173):

> Scaffolding is a normal process present across the lifespan that involves use and development of complementary, alternative neural circuits to achieve a particular cognitive goal. Scaffolding is protective of cognitive function in the aging brain.

These three theories also suggest that cognition has a chronological element to it. Addressing what they termed the "Cognitive Reserves of the Aging Mind" Baltes and Smith (2002) cited work by Schaie (1996) to claim that, in developed countries, people maintain mental achievement levels until about age 70. However, beyond that age, new learning can be severely impaired for some seniors: these researchers later claimed that sizeable losses in people's ability to learn can occur for people over 85. This is one aspect of mechanics, the ability to process new information. One implication of this for designers, in that it means that, particular care needs to be taken with those seniors over the age of 70, who may require

help to cope with the cognitive demands that interacting with websites can place upon them. Such design considerations increase in importance the older users are, and become particularly critical for some senior users over the age of 85. Thus, the focus of design efforts should be on assisting seniors to compensate for the cognitive, biological losses that increase with increasing age.

Pragmatic Cognition

Pragmatic cognition relates to the previously mentioned studies that show that patterns of sociability established early in life can be continued as people age. Although there is evidence in psychological, epidemiological and other medical literature for various types of cognitive decline, the link between pragmatic cognition and verbal knowledge is supported in this literature. Such research is claimed to have originated with the Nun Study, which was a longitudinal study of aging and Alzheimer's disease, and which followed 678 "Catholic sisters 75 to 107 years of age who [were] members of the School Sisters of Notre Dame congregation" (Snowdon 2003). These nuns either kept journals of their daily activities, thoughts and feelings, or did some other non-verbal tasks. The researchers found that the nuns who focused on the verbal task had significantly lower rates of dementia and Alzheimers than the nuns who were not verbally oriented (Snowdon 2003; Tyas et al. 2007).

One study revealed a link between continuing social interaction and good mental health for seniors and the converse, namely that seniors who were isolated from social interaction were more likely to suffer a range of health problems, including mental health (Sum et al. 2008). Another study found a link between communication skill maintenance (not limited to verbal communication) and mental health (Worrall et al. 1998). Such research reinforces the positive mental health benefits of using information and communication technologies (ICT) for social interaction and communication. However, a study by Dickinson and Gregor (2006), claimed that assertions made by prior studies concerning benefits to the well-being of seniors, by one form of technology or another, could not be empirically verified. Interestingly, their review predominantly concerned quantitative studies, which claimed a causal effect on the well-being of seniors, but they also discussed qualitative research which suggested that effects on the well-being of seniors could not be attributed to technology alone. Dickinson and Gregor further stated that, there was some evidence, based on the results of two studies, that the greater connectivity and social networking, facilitated by computers, could assist to reduce the isolation experienced by some seniors, and that therefore, computers contributed to improvements in the well-being of seniors. Thus, one can postulate that online community technologies, such as those of GreyPath, may not increase the mental well-being of seniors per se, but instead, it is the social interaction that is facilitated by such technologies that enhances their mental well-being.

Implications of Cognitive Ageing Theories

Three implications arise from these psycho-social cognition-oriented theories. One is that they lend support to the notion that the social capital available to seniors, through dedicated online communities such as GreyPath, can engage them in the types of cultural and communication activities, that increase the likelihood of maintaining, at the least, the pragmatic cognitive function which they have built up over their lifespan (Sum et al. 2008). Studies have shown that online communities involving seniors, increase the quality and quantity of social interaction experienced by those seniors, and this includes those who are house-bound due to age-related disabilities, and those in institutional care (Burmeister 2010; Jaeger & Xie 2008; Pfeil 2010). In other words, pragmatic cognition can be maintained and even enhanced by design that improves social interaction and communication amongst

seniors. A second implication, relating to mechanics, is that new learning is difficult for some seniors over the age of 70 and, for increasing numbers of seniors, the older they become, especially those over 85 (Baltes & Smith, 2002).The third implication, also relating to mechanics, is that new learning difficulties can, to some extent, be mitigated by providing seniors with contextual information (Craik 1999).

Mechanical Cognition Findings

The challenges of mechanical cognition to design are best illustrated in the discussion of the extrinsic value of *structure*, mentioned in the methodological discussion, above. As described there, extrinsic values are valued not for themselves, as are intrinsic values, but for the things they lead to, such as enhanced social engagement with other seniors, in this case. The comments that gave rise to this value were predominantly the result of responses to a particular question in the interview schedule. If participants had indicated that they had been members since before the site restructure in October 2006, then they were asked to reflect on the differences between the old and the new website. That led to comments about participant values to do with the structure of the website. In a few instances, such comments were also made in other parts of the interview and not always by participants who were members prior to October 2006.

One reason that GreyPath management considered it important to restructure the web site in 2006 was to enable better long-term use of the portal. Looking ahead, they could see that their initial structure could not adequately cater to the forecast future needs of their user base. The restructure appeared to be a sensible business decision at the time, but proved very costly in terms of membership for GreyPath. For at least three months after the restructure, the volume of traffic on GreyPath was dramatically reduced. Some of the reasons, as seen from members who stayed on through that change, are seen below. In the main the comments concerning what was valued about the structure involved three areas: login requirements, site layout and the ordering of activities on the site.

Login Requirements

Immediately following the restructure of the GreyPath website, members experienced difficulties accessing the site. Public viewing of the site was unaffected by the restructure. However, in order to make a contribution to the site, members had to login and that proved difficult and frustrating, as is illustrated in the following examples:

> Having to sign in then and forgetting my password and things. Whereas before I could go straight [in]. … Now I've got to remember my member name to put it in to get there, and I feel that it's not quite as accessible as it was. [Female, TAS, 70-74]

> I'll be honest with you, when it changed I found it difficult, because I was so used to the other site… You had to sign in, whereas before you really didn't have to sign in… I've got a very good memory but, I used to forget my password. So finally [the administrator] who was the convener, he changed my password, so I would remember [laughing]. I mean, the thing is, you've got a password for, I've got a password for that, and then I have a password for online Telstra and all that sort of stuff. And so, we've made it easy. [Female, Vic, 75-79]

> The chat room changed considerably… I had a lot of trouble getting in after the change, you know. There was nine times out of ten it wouldn't accept the

> password and then when you got in there, there was hardly anyone ever there, so, I just stopped going. [Male, SA, 70-74]

The above quotations show that requiring registration caused a lot of problems. In part, there was a genuine problem with the logging-in system at first; it was a bug in the system, which the development team resolved within the first fortnight. In part, as seen in the quotation above, mentioning Telstra (Australia's largest telecommunications company), everyone has multiple passwords to remember. Given memory and other cognitive limitations that come with increasing age, this is likely to be a greater problem for seniors the older they become.

In the last quotation, a related problem was highlighted, namely the snowballing effect of the problems with login registration. Because so many members experienced problems, they could not access the site. In turn, because so few successfully accessed the site, when they did, they found the social interaction quite poor, because of the low numbers. Two participants interviewed said that they stopped going to GreyPath, in one case for a whole year. In the other case the participant only returned to GreyPath infrequently and still only does that even though, prior to the restructure, she was on the site multiple times per week.

Site Layout

Some participants preferred the way the site was structured previously. Others preferred the layout of the new site. Regardless of which was preferred, what it was that participants preferred about the layout is what is important for this discussion. Examples illustrating how the site layout was interpreted by participants follow:

> The layout they had, was very, very easy to follow. And when they switched it to the format that they have adopted now… you can see why people have moved away. On the first page that you now get in the Senate Forum for argument's sake, there are probably about three or four questions there, and they're answered in consecutive answers by date and name and so on. And then you've got to click to another page, and another page, and another page, and another page. Whereas on the old format… all the questions were on one page. [Male, QLD, 65-69]

This man preferred scrolling and having related information together in large documents or in an expanded email tree structure, as opposed to being required to move forward and backward through multiple layers, to find the information. Although this supports Hanson's (2009) literature review that revealed that, senior web users experience difficulty navigating backwards and forwards through web pages, it also contradicts her assertion, that scrolling is counter-intuitive for seniors and ought to be avoided. Similarly the next example is from a participant who liked to be able to access everything in the site from the home page. That is, he could scroll down the home page to the link he wanted:

> I think the new site's a lot better … it's more accessible. It's all on the front page where you want to go. Before you had to click on things and go to different areas, but now, with the new site, you can see everything down on the left hand side in the directory, so you can go wherever you want. [Male, VIC, 65-69]

The context of the responses reveals the importance of scrolling, as a means to reduce the cognitive load on seniors, whilst browsing the website. The old site did not permit scrolling from the home page, which the man in the last quotation prefers; hence his preference for the new site. Likewise, the man in the previous quotation, preferred the old site, in relation to forum usage, because it permitted scrolling, whereas the new site does not.

Order of Activities

Another issue that revealed participant interpretations of structure, was that of how the site was ordered. In a sense this was closely related to layout, although it was not necessarily the same thing:

> I found it was quite a good innovation [the new site] with reading articles on the forum. They're in some sort of order, that come about with that, which was terrific, because previous to that, you would have to look at the postings, the time and the date, to find out who said what last. [Male, NSW, 70-74]

As is indicated in the next quotation, not everyone agreed with this assessment:

> In many ways it's not better, I think, because you can't follow the threads as easily. … I actually forget how they were set out, but I know it's a lot more fiddly now. … The pages aren't as long either, the topics move off the page quite quickly. The pages are shorter. [Female, VIC, 75-79]

This quotation is an example of a preference by participants for a flat structure, one that avoided the need to click to access another level and click to access yet another level. Some participants appeared to prefer a structure where there was a lot of scrolling, where everything that logically belonged together, was together.

The final two illustrations of the value *structure*, also suggest that the problems with the change-over from the old site to the new one, might have been the result of the age of the users of the site. Aside from these two members, others also said they felt their problems were partly attributable to their age. One because he was almost 75, another because she was almost 80.

> I preferred the old one, but again, I think you've got to look at it from our age group point of view. You get sort of set in your ways and you like something you've started off with, and suddenly they sort of change all the format, and you've got to start reworking the whole thing. And there was a lot of people in the forum and that Coffee Shop [Forum] that were writing in saying the same thing. That they had got so used to the old one and it was quicker and easier to use as such. They could find things easier. [Female, Travelling, 65-69]

> They've lost people because the format has changed dramatically, and elderly people, or mature people I should call it, they are funny, they like a certain set up without having to change too often. [Male, QLD, 65-69]

The assertion that chronological age may be a factor is based on the above mentioned SOC study (Baltes & Smith 2002) that indicated that above age 70, and particularly above age 85, some seniors experience learning impairments. Prior to the commencement of this study, GreyPath management told this researcher that the average age of 'active' members was in their high 70s and low 80s; that was approximately one year prior to the site restructure. GreyPath participation had grown from 1,200 to 2,000 participants per month in 2001, to between 5,000 to 6,000 participants per month in 2002 (Lepa & Tatnall 2002), and to the point when, in early 2006, the home page of GreyPath proclaimed a monthly participation of 45,000. By the end of 2006 total membership had dropped to 3,000 and it only slowly recovered, growing to 5,500 members by April 2008 (Lewis 2008). The latter growth in new members had come from younger seniors, seen by the fact that the majority of active members in April 2008 were in their late 60s (Lewis 2008). One reason for that demographic change might be the restructure of site. That is, because of their age, most of the active members prior to the restructure found coping with such a substantial change too difficult and

therefore ceased using the site. Given the theory of ageing SOC, it is likely that new participants joining the online community were predominantly younger seniors, given the learning impairment (an aspect of mechanical cognition) experienced by some seniors the older they become. There is indirect support for the views expressed here, in that Hanson (2009) claimed that a digital divide, that existed between seniors over 70 and younger seniors, was shrinking. She pointed to various studies that showed that Internet use amongst seniors mostly involved younger seniors. Perhaps that divide is due to a lack of support in websites for the mechanical cognitive declines, experienced by some older seniors?

Discussion

The discussion above, focused on the immediate ramifications of the quotations. Here the discussion brings the ramifications together, to address specific usability considerations, in regard to issues of accessibility involving cognition. This discussion is in two parts, with the first addressing the major finding, and the second addressing other usability issues.

Adaptation to Substantial Change

The findings reported above, focused on the value *structure*. However, as stated in the methodology section, that value was closely related to another value in that same theme, labelled *variety*. That is, study participants highly valued the multifaceted nature of the GreyPath website and the fact that continual improvements and changes were being made to it. The two values are related, in that they both relate to structural changes. Variety-based website changes occur frequently, and most of them are small, incremental, and expected changes. The site restructure in October 2006 was substantial and only expected to a limited extent. GreyPath members were only told about the upcoming change two months before it happened, and were only given one month to trial the new site (September 2006), before the changeover from the old to the new site occurred. Also, GreyPath participants were not given an opportunity to have input into the design of the new site.

A study reported by Kurniawan (2008) found that when complex technologies were introduced to seniors, they could not cope cognitively with those complexities. Kurniawan therefore recommended that interfaces for seniors be simple, with few choices and limited functionality. The GreyPath data however, reveal that seniors coped well with complexity. Seniors interviewed for this study ranged in age from their late 50s to their late 80s. It seems from the present study that it is not complexity that is a cognitive problem to seniors, but the suddenness of adaptation that was required with the restructure. As the SOC research revealed, the older a person is, the harder it becomes to acquire new knowledge (mechanics), whilst maintaining previously acquired knowledge is much easier. New learning is possible, but it takes more time than for younger generations. Therefore in the Kurniawan study, which introduced a new technology to seniors and found that they struggled to learn it, the conclusion was that complexity was a problem for seniors; instead the problem may have been in the area of the new learning involved. The restructure of the GreyPath site showed that, prior to that change, 45,000 seniors visited the site every month and coped fine with the complexities involved, as do GreyPath members using the current site. The problem was that the change to the new site required many new learnings in a relatively short space of time, and that proved problematic for particularly the older members of GreyPath.

Support for the view that significant new learning rather than technical complexity is a cognitive problem for seniors, with the introduction of new technology, can be found in the work of Kang and Yoon (2008). Their research showed that the ability of seniors to cope with cognitive tasks varied to some extent on the basis of the background knowledge or the prior

experiences of the seniors involved. Relating that to GreyPath, it suggests that the seniors who coped best with substantial change were those who had prior experience in using the site. That is, existing, experienced members were more likely to cope better with substantial changes than new members. Further support can be found in the work of Ziefle and Bay (2004), who compared learning to use mobile phone menus for young and old adults. Although their study was based on novice users, one could argue that subsequent to the restructure, GreyPath users were novice users, at least as far as the menu structures were concerned, because they had radically changed. In their study, Ziefle and Bay (2004) found that whether older users had prior experience or not with mobile phones, when the menu structure changed significantly, the mental models of these users for mobile phone use, were no longer valid. They associated this with cognitive abilities to process information (mechanics). Similarly, the aforementioned work by cognitive ageing researchers, showed that one form of compensating for episodic memory decline, is by providing seniors with supportive contextual information (Craik 1999). This suggests that if GreyPath management had provided a schema of the new navigational structure, then older users might have been better able to cope, given that their own mental models of the structure of GreyPath were no longer valid. Moreover, the Ziefle and Bay (2004) study only worked with seniors up to the age of 64, whereas the SOC theory says that it is above age 70 that more seniors will experience learning difficulties. Therefore helping seniors of all ages, and particularly older seniors, to form valid mental models of the site structure, is one important design consideration.

Another consideration is that seniors require more time to adapt to substantial change, than younger users. For example, a study by Barrett and Kirk (2000) suggested that the ability to process information (mechanics), slows for older people. Learning to cope with excessive change, as judged by the GreyPath experience, showed that one month to adapt to the changes was insufficient time for many members in their late 70s and early 80s. One implication is therefore, that designers should permit the continuance of previous navigational structures, when new ones are introduced, so that older participants are not forced to engage in (for them) cognitively difficult new learnings. Another approach could be to progressively change a web site over a period of months, rather than to change the entire web site all at once, as GreyPath did in 2006.

Further research is required to determine the types of changes that affect the cognitive abilities of seniors and the extent to which those changes affect seniors. That is, when is change so substantial that seniors cannot cope with it? When is the frequency of change such that seniors cannot cope with it? Over how long a time period should changes be introduced in order for seniors to adapt to the change?

Further Usability Considerations

Two further usability considerations, involving cognition and website access, arose from the value *structure*. Firstly, participants preferred a flat structure, to one with sub-parts which in turn had more sub-parts. Again, this is an issue of mechanics, in that it concerns the ability to process information. This issue had some support in the literature. Preece (2000) reviewed early Internet research involving seniors and concluded that 'simpler command sequences' were important. Hanson (2009), reported that a literature review had revealed that senior web users experienced difficulty navigating backwards and forwards through web pages. Similarly, in support of their own findings concerning seniors' use of complex mobile phone menu structures, Ziefle and Bay (2004) used the results of previously reported studies, to show that seniors coped poorly with deep menu structures, when compared to younger users. Related results were also reported for a study by Rice and Alm (2008), who

prototyped four designs of digital TV menus with seniors. Rice and Alm (2008) claimed that their participants preferred clear and concise menu navigation, and that conventional menus that concealed information, through the use of drop-down and scrolling menus, were problematic to their participants. Still another study, involving email use amongst Spanish seniors (Sayago & Blat 2010), found that seniors did very little management of attachments and directory structures, because it reduced their cognitive load to have as few email folders as possible. In other words, favouring a flat structure in site design might be related to a reduced cognitive (memory) load for seniors. Whether catering to menu structures, forums, or other technologies, designers should therefore minimise the need to click through multiple pages. On the other hand, designers could cater to senior users, by creating alternate navigational structures, that permit scrolling through content, rather than forcing all users to navigate through multiple pages.

Finally, the comments by participants concerning login difficulties, about having to remember multiple passwords for various online accounts (not just GreyPath), and the hint at a solution employed by the GreyPath administrator, seen in one of the participant quotations, suggests that memory aids can be helpful. Craik (1999: 75) reviewed various psychological studies of memory and ageing and concluded that the "general consensus is that memory performance does decline in older adults." This suggests that some type of functional aid is needed, which supports registration processes, particularly in regards to remembering passwords.

Conclusion

The present study examined what members of a particular online community for seniors, most valued about their online social interaction. It employed a VSD methodology, using ethnographic techniques. One of the six themes that emerged from the study revealed that some seniors experienced accessibility challenges to do with cognitive functions. A review of cognitive ageing literature revealed that, these cognitive access challenges concerned what is described as mechanical cognition. The main finding was that for seniors over the age of 70, more needs to be done to assist them to adapt to major website changes. The restructure of the GreyPath website in October 2006, appeared to confirm this, in that, there was a significant decline in membership and in that, the average age of users dropped from the high 70s and low 80s, to the high 60s.

Three specific usability considerations arose from the study that can assist seniors to cope better cognitively, when accessing websites. Firstly, it was the suddenness of the changes to the GreyPath site, as opposed to those changes per se, which created difficulties for some seniors. Introducing substantial changes more gradually is therefore recommended for older seniors. In addition, providing contextual information will assist seniors to develop valid mental models, of the changed website structure. The other two usability considerations were, the importance of a flat navigational structure, and of providing functional, memory aids. As further research is conducted into the cognitive needs of seniors, when accessing websites, the recommendations in this paper and those of future research, will result in websites that not only attract and retain more senior users, but which more richly provide an inclusive, virtual environment, that caters to the needs of senior users.

Acknowledgements

I am indebted to Benjamin Bradley, Professor of Psychology, Charles Sturt University, who reviewed an early draft of this paper, and to the anonymous iJETS reviewers. The insightful comments from these people, helped to enrich the final product.

References

Baltes PB 1997, 'On the incomplete architecture of human ontogeny: Selection, optimization, and compensation as foundation of developmental theory'. In PB Baltes & OGJ Brim (eds.) *Life-Span Development and Behavior.* New York, Academic Press.

Baltes PB & Smith J 2002, 'New frontiers in the future of ageing: From successful ageing of the young old to the dilemmas of the fourth age' *Keynote lecture at the Valencia Forum, International Scientific Congress,* Valencia, Spain, 1-4 April.

Baltes PB, Staudinger UM & Lindenberger U 1999, 'Lifespan psychology: Theory and application to intellectual functioning' *Annual Reviews Psychology,* vol. 50**,** pp. 471-507.

Barrett J & Kirk S 2000, 'Running focus groups with elderly and disabled elderly participants' *Applied Ergonomics***,** vol. 31, pp. 621-629.

Burmeister O.K 2010, 'Virtuality improves the well being of seniors through increasing social interaction'. In: J. Berleur (ed.) Human Choice and Computers *HCC9/CIP 2010, International Federation for Information Processing IFIP AICT 328.* 20 - 23 September. Brisbane, Australia, IFIP.

Craik FIM 1999, 'Age-related changes in human memory'. In: D. Park & N. Schwarz (eds.) *Cognitive Aging: A Primer.* Philadelphia, Psychology Press.

Dickinson A & Gregor P 2006, 'Computer use has no demonstrated impact on the well-being of older adults' *International Journal of Human-Computer Studies,* vol. 64**,** pp. 744-753.

Dourish P 2006, Implications for design. *International Conference for Human-Computer Interaction* (*CHI) 2006,* Montreal, Quebec, Canada, 22-27 April.

Flanagan M, Howe D & Nissenbaum H 2008, 'Values in design: Theory and practice'. In: J. Van Den Hoven & J. Weckert (eds.) *Information Technology & Moral Philosophy.* Cambridge, Cambridge University Press.

Friedman B, Kahn PHJ & Borning A 2006, 'Value sensitive design and information systems'. In: P. Zhang & D. Galletta (eds.) *Human-Computer Interaction & Management Information Systems: Foundations.* New York, M. E. Sharpe.

Hanson VL 2009, 'Age and web access: The next generation'. *W4A2009 - Technical.* (Web - 4-All, International Cross-Disciplinary Conference on Web Accessibility), Madrid, Spain, 20-21 April.

Jaeger PT & Xie B 2008, 'Developing online community accessibility guidelines for persons with disabilities and older adults' *Journal of Disability Policy Studies,* vol. 20**,** pp. 55-63.

Joint Academy Initiative on Aging 2010, *More Years, More Life.* German Academy of Sciences Leopoldina – National Academy of Sciences, Halle, Germany.

Kang NE & Yoon WC 2008, 'Age- and experience-related user behavior differences in the use of complicated electronic devices'. *International Journal of Human-Computer Studies,* 66**,** 425-437.

Kurniawan S 2008, 'Older people and mobile phones: A multi-method investigation' *International Journal of Human-Computer Studies,* vol. 66**,** pp. 889-901.

Lepa J & Tatnall A 2002, 'Exploring consumer loyalty to web sites: Why older Australians return to the GreyPath portal'. In: N. Lethbridge (ed.) *3rd International We-B Conference* 28-29 November. Edith Cowan University, Churchlands, W.A.

Lewis R 2008, 'Greypath Usage Stats'. Personal Communication, Melbourne, Australia.

Malta S 2007, 'Love actually! Older adults and their romantic Internet relationships' *Australian Journal of Emerging Technologies and Society,* vol. 5**,** no. 2, pp. 84-102.

Marsiske M, Lang FR & Baltes PB 1995 'Selective optimization with compensation: Life-span perspectives on successful human development'. In: RA Dixon & L. Baeckman (eds.) *Compensation for Psychological Defects and Declines: Managing Losses and Promoting Gains.* Hillsdale, NJ, Erlbaum.

Morse JM 2008, 'Confusing categories and themes' *Qualitative Health Research,* vol. 18**,** pp. 727-728.

Park DC & Reuter-Lorenz P 2009, 'The adaptive brain: Aging and neurocognitive scaffolding' *Annual Review of Psychology,* vol. 60**,** pp. 173-196.

Patton MQ 2002, *Qualitative Research & Evaluation Methods,* Thousand Oaks, CA, Sage.

Pfeil U 2010, 'Online support communities'. In: P. Zaphiris & CS Ang (eds.) *Social Computing & Virtual Communities.* Boca Raton, FL, Taylor and Francis.

Pfeil U & Zaphiris P 2009, 'Theories and methods for studying online communities for people with disabilities and older people'. In: C. Stephanides (ed.) *The Universal Access Handbook.* Taylor and Francis, Boca Raton, FL

Preece J 2000, *Online Communities: Designing Usability, Supporting Sociability.* Baltimore, MD, John Wiley & Sons.

Rice M & Alm N 2008, 'Designing new interfaces for digital interactive television usable by older adults' *ACM Computers in Entertainment,* vol. 6**,** pp. 1-20.

Sayago S & Blat J 2008, 'Exploring the role of time and errors in real-life usability for older people and ICT'. *Lecture Notes in Computer Science,* vol. 5105**,** pp. 46-53.

Sayago S & Blat J 2010, 'Telling the story of older people e-mailing: An ethnographical study' *International Journal of Human-Computer Studies,* vol. 68**,** pp. 105-120.

Schaie KW (1996) *Intellectual development in adulthood: The Seattle longitudinal study,* New York, NY, Cambridge University Press.

Schwandt TA 2003, 'Three epistemological stances for qualitative inquiry: Interpretivism, hermeneutics and social constructionism'. In: NK Denzin & YS Lincoln (eds.) *The Landscape of Qualitative Research,* 2nd Edition. Thousand Oaks, CA, Sage.

Snowdon DA 2003, 'Healthy aging and dementia: Findings from the Nun Study' *Annals of Internal Medicine,* vol. 139**,** pp. 450-454.

Stern Y 2009, 'Cognitive reserve' *Neuropsychologia,* vol. 47**,** pp. 2015-2028.

Sum S, Mathews MR, Pourghasem M & Hughes I 2008, 'Internet technology and social capital: How the internet affects senior's social capital and wellbeing' *Journal of Computer-Mediated Communication,* vol. 14**,** pp. 202-220.

Tyas AL, Snowdon DA, Desrosiers MF, Riley KP & Markesbery WR 2007, 'Healthy ageing in the Nun Study: Definition and neuropathologic correlates' *Age & Ageing,* vol. 10**,** pp. 1-6.

Williamson K 2006, 'Research in constructivist frameworks using ethnographic techniques' *Library Trends,* vol. 55**,** pp. 83–101.

Worrall LE, Hickson L, Barnett H & Yiu E 1998, 'An evaluation of the Keep on Talking program for maintaining communication skills into old age' *Educational Gerontology,* vol. 24**,** pp. 129-140.

Xie B 2008, 'Multimodal computer-mediated communication and social support among older Chinese internet users' *Journal of Computer-Mediated Communication,* vol. 13**,** pp. 728-750.

Ziefle M & Bay S 2004, 'Mental models of a cellular phone menu. Comparing older and younger novice users' In: S. Brewster & M. Dunlop (eds.), *Mobile Human-Computer Interaction - MobileHCI 2004,* Springer-Verlag, pp. 25-37.

Zimmerman MJ 2010, 'Intrinsic vs. extrinsic value'. In: E. Zalta (ed.) *Stanford Encyclopedia of Philosophy.* Stanford, CA, Stanford University.