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This study focuses on the effects of Mild Cognitive Impairment and other minor memory impairments on a person's ability to successfully use the Internet. Participants over sixty-five years of age were recruited from retirement communities and were selected based on self-reports of Mild Cognitive Impairment or other cognitive difficulties when using the Internet. Interviews with the participants focused on their abilities to use Email, Chat/Instant Messenger and the World Wide Web. Participants were then asked to step through several Internet-related tasks in order to further identify problem areas. Seven participants were interviewed, and six of them completed the optional observation session. The data collected from the interviews and observation sessions were then broken down into different categories, based on the type of difficulties experienced during Internet use. Finally, recommendations were made for good Web design practices intended to overcome the difficulties identified during the study.

Headings:

Aged

Cognition/Internet resources

End-user searching

Use Studies/Internet

Websites/Design

AN EXPLORATORY STUDY OF THE EFFECTS OF MILD COGNITIVE
IMPAIRMENT ON ELDERLY INTERNET USERS

by
Joshua D. Berkov

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of the University of North Carolina at Chapel Hill
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Approved by

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Barbara Wildemuth

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INTRODUCTION

Since it's inception in the early 1990's, the Internet has become an increasingly important aspect of every-day life. People use the Internet for a wide range of tasks and activities from sending letters (Email) to conversing instantaneously (Chat and Instant Messenger) to conducting information searches (the World Wide Web). E-commerce has become an ever-increasing means by which consumers shop for products, using websites such as Amazon.com and EBay. And people are even managing their financial assets over the Internet with tools such as online banking and electronic stock trading websites.

The wide-spread proliferation of the Internet, as is the case with many new technological innovations, requires the population at large to learn and develop a new set of skills. Regular users of the Internet learn to understand and implement new syntax languages for websites and email addresses, and some users also learn how to operate instant communications programs such as Chat and Instant Messenger. Once learned, these skills can become second nature for users.

Mastering the Internet can be a daunting task for elderly users. These users face all sorts of obstacles that younger users are better-equipped to overcome. Elderly Internet users are faced with the challenge of adapting to a technology that they never thought they would need to learn and a technology with which they are unfamiliar. In addition, the aging process can inflict physical and cognitive limitations on various day-to-day activities. The eyes may begin to degenerate, causing partial or total loss of vision (*Age-Related Macular Degeneration* 2006). The sense of hearing may diminish, and the range

of frequencies audible to the ear may decrease. Arthritis and Parkinson's Disease strike a large percentage of elderly people, causing pain in their joints and hindering mobility and dexterity (Arthritis - Data and Statistics 2006).   Finally, neurological disorders such as Mild Cognitive Impairment, Dementia, and Alzheimer's Disease can result in forgetfulness, decreased mental performance, and even an eventual total loss of memory and cognitive function (*Understanding Stages* 2007).

Understandably, some elderly people choose not to take advantage of what the Internet has to offer because they have lived their lives for many years without it. Some choose not to learn how to use the Internet because they feel they are past the point in their lives when they can adapt to new technology. Then there are elderly users who try to learn how to use the Internet, but they fail in their attempts for various reasons. Those with Mild Cognitive Impairment, Dementia, and Alzheimer's Disease are impeded in their ability to learn and remember the new tasks associated with Internet use. Others have visual impairments that render many websites illegible due to small font sizes and poorly contracting colors. Finally, some users ultimately become disenfranchised with the Internet (and specifically the web) because their decreased motor skills turn the task of clicking on desired links and navigation tools into a virtual game of darts with an exceedingly small bull's-eye.

Many of the physical difficulties associated with advanced age that affect a person's ability to use the Internet can be mitigated by designing websites with larger, simpler fonts and well-chosen color schemes. However, what steps can web designers take to help elderly users who have mental impairments? Websites such as www.medicare.gov and http://nihseniorhealth.gov, sites that are likely to be frequented

by elderly users, have been designed to help overcome the physical obstacles, but would a user with early-stage Alzheimer's Disease be able to navigate through these sites' pages? Web designers may wish to consider the difficulties associated with a decrease in mental acuity that is sometimes associated with age and illness.

Furthering this train of thought, each type of mental illness is unique, and some of the limitations imposed on its patients may be unique to that illness. Mild Cognitive Impairment (MCI) is a mental state at which a patient's cognitive decline becomes greater than what is expected for the patient's age (Gauthier et al. 2006). Alzheimer's Disease and other forms of full-blown Dementia are more extreme and affect a greater range of cognitive functions. Thus, MCI patients may be able to accomplish tasks using the Internet that patients with the other two impairments may not. MCI patients may also have an advantage over Dementia patients in remembering how to complete certain tasks recently learned. This ability to remember and repeat tasks is a crucial component in learning how to use the Internet.

The purpose of this exploratory study is to begin to understand the difficulties faced when using the Internet by a group of elderly people who have Mild Cognitive Impairment and other cognitive impairments of similar nature and severity   The results of this study will form the basis for recommendations to Web designers and programmers to make the Internet more accessible to this subset of the population.

LITERATURE REVIEW

This literature review is an attempt to piece together information from several related disciplines. It begins with a review of relevant literature on the topic of elderly Internet users. A review of cognitive impairments and the basic symptoms of Mild Cognitive Impairment follows. The distinctions between MCI and other neurological disorders are outlined, and the effects of cognitive decline (regardless of the diagnosis) on Internet usage are discussed.

Elderly Users of the Internet

Decreased vision affects an overwhelming percentage of people over the age of 65, and previous studies have produced recommendations for Web Designers to mitigate this obstacle. Font size on the web is as important as font size in print. Elderly people tend to have more difficulty reading smaller print, and this issue is then exacerbated when small text appears with decreased clarity on a computer screen. Published recommendations (Making your Website Senior Friendly, 2002; Kurniawan & Zaphiris 2005) suggest using 12 point or 14 point font to make text more easily readable for elderly users.

In addition to the font size, elderly users may have trouble reading certain font faces. In order to design websites that are accessible to elderly users, designers should use sans-serif fonts such as Helvetica, Arial, Univers, News Gothic, or Verdana (Kurniawan & Zaphiris 2005; Making Your Website Senior Friendly 2002). Sans-serif fonts lack the decorative end pieces of their serif counterparts, thus these fonts are easier

to read when the font size has been set below 12pt. The lack of decoration increases the amount of white space around each letter, which increases the clarity of each letter.

The visual obstacles faced by elderly Internet users are further complicated by the text/background color contrast that some designers choose to implement. Hanson (2004) argues for color/contrast control to be included in software designed to support Internet surfing using a standard browser. Hanson (2001) also mentions the difficulty in reading text set upon a background image. To address some of these concerns, designers should stay away from using blue, green, and yellow within close proximity of each other. In addition, designers should use dark type against light backgrounds or white lettering against dark backgrounds (Making your Website Senior Friendly 2002).

In addition to the visual obstacles faced by elderly Internet users, some also experience decreased motor-reflex skills. Milne (2005) suggests that older people have a difficult time clicking on links they wish to use, and that impaired motor skills are at fault as is the lack of familiarity with using a mouse. Milne also points out that users must keep the mouse fairly stable while clicking on the link. Such stability can elude elderly users with Parkinson's disease and other related neurological disorders.

The need for clear navigation structures has been previously studied as well. Becker (2004) lists navigation as one of many design obstacles that older users face when using the web. As we age, our ability to learn new tasks, especially those involving unfamiliar technology, diminishes. To the extent that these abilities diminish varies from one person to another, but Greger, Newell, and Zajicek (2002) have shown that most are affected to some degree. Website navigation needs to be made simple and obvious in order for elderly users to succeed in their virtual endeavors.

Causes of Cognitive Impairments

There are two umbrella categories of cognitive impairments. Mild Cognitive Impairment encompasses minor changes in mental acuity; and Dementia, which includes Alzheimer's Disease, encompasses more severe cases of mental deterioration. In some cases, MCI can be a precursor to a more severe diagnoses of Dementia, but for others, their mental decline into a state of MCI eventually stabilizes before descending into full-blown Dementia. And in others, their level of mental decline may even improve, thus taking them out of the MCI category.

Cognitive impairments vary in range of severity, but they also vary in cause. Traumatic Brain Injury (TBI), the result of an injury or blow to the head, can leave patients with cognitive impairments from changes in personality to amnesia to debilitating cognitive impairments that act as barriers to social function (Gordon 2005). Gordon (2005) further discusses various characteristics of TBI, and points to a trend in which patients with TBI tend not to suffer further decline in cognitive impairments after the initial blow; rather the level of cognitive decline remains stable or actually improves. In any case, while TBI may result in a form of Mild Cognitive Impairment, such occurrences typically are not precursors to Alzheimer's Disease or other forms of Dementia.

Patients who suffer a stroke may also suffer from cognitive impairments. As is the case with TBI, the cognitive impairments caused by a stroke can remain stable or improve (Gordon 2005). However, there is also evidence linking the occurrence of a stroke with a subsequent/eventual diagnosis of Dementia (*Stroke and Dementia* 2004) and, depending on the severity of the stroke, the level of cognitive impairment may vary.

Those who suffer silent strokes, small blockages in arteries that supply blood to the brain, may also exhibit declines in cognitive function (Cleveland Clinic 2004). While this type of stroke may not induce the physical symptoms of a more massive stroke (such as partial paralysis and loss of speech), some of the cognitive effects of more severe strokes can still show up. These silent strokes are considered to be caused, in part, by vascular diseases (Mayo Clinic 2006).

Parkinson's Disease can directly cause cognitive impairments and can indirectly cause such impairments through the use of certain medications to treat the disease. Parkinson's Disease occurs when the brain's production of dopamine, a neurotransmitter, is reduced (Gordon 2005). Early symptoms are more physical, as previously mentioned, but the medicines used to treat those physical symptoms can also produce cognitive side effects. As the disease takes hold, patients can become forgetful and may experience lags in thought processes and slowed learning processes (Rosner & Henchcliffe 2003).

Mild Cognitive Impairment

Regardless of the cause, there exists a level of cognitive impairment at which the patient is somewhere between normal cognitive function and full-blown Dementia, and this level is known as Mild Cognitive Impairment. Mild Cognitive Impairment (MCI) cannot be diagnosed to a level of certainty as can viral or bacterial diseases. According to Ganguli (2006), there is no precise point at which cognitive decline can be defined as MCI, nor is there an exact point at which cognitive decline descends from MCI into clinically-diagnosed Dementia. Instead, MCI is considered to be a state of cognitive decline that slots between normal, age-related decline and dementia (Ganguli 2006). Gauthier et al. (2006) state that cognitive decline should also be measured against the

expected level of decline for a patient's education level, but notes that any decline associated with MCI should not significantly affect the activities and tasks of daily life (a point of contention discussed further on). In other words, diagnoses such as Alzheimer's Disease and other forms of Dementia require a more significant level of cognitive decline than does MCI, but there is no single line that divides all MCI patients and all Dementia patients.

As mentioned, Mild Cognitive Impairment is a mental state at which a patient's cognitive decline becomes greater than what is expected for the patient's age. However, different studies have derived differing criteria and standards by which such decline is measured (Ganguli 2006). These differing standards then lead to different levels of diagnoses of MCI in terms of percentages of the population. This variability also complicates attempts to assess the percentage of the population (within a given age range) afflicted with MCI because differing standards and criteria can place a given patient past the divide between MCI and Dementia as well. A given patient could be diagnosed with MCI according to one set of standards, while the same patient could be diagnosed with Alzheimer's Disease by another.

There is some uniformity in measuring the severity of cognitive decline through the use of two different scales. However, researchers do not always agree when applying labels such as MCI or Alzheimer's Disease to the levels of these two scales (Gauthier et al. 2006). The Clinical Dementia Rating (CDR) has a scale of zero to three, zero representing normal cognitive function and three representing severe impairment (Gauthier et al. 2006; Lu et al. 2005). Between zero and one (which represents mild impairment), a score of .5 exists and is labeled "questionable impairment." The

disagreement stems from whether the .5 level of the CDR is fully compatible with accepted definitions of MCI, or whether a patient at this level on the CDR could be diagnosed with a mild level of Dementia. This may be due to the label of the particular level; though the disagreement may also come from a disparity in diagnosis methods for MCI and Dementia across the field.

In addition to the Clinical Dementia Rating, there is also the Global Deterioration Scale for Ageing and Dementia (GDS). Of this seven-point scale, the first two indicate no objective cognitive decline (Gauthier et al. 2006). In other words, there is no clinical evidence of any cognitive decline for patients ranked at these levels, though it should be noted that the second level is defined by subjective cognitive decline. This means that patients are self-diagnosing with symptoms of cognitive decline, but such symptoms are not showing up on clinical tests. The third level, however, does allow for clinical evidence of subtle cognitive decline and the rest of the levels represent various levels of clinically-diagnosed Dementia. Again, there is disagreement as to whether level 3 is a perfect fit for Mild Cognitive Impairment or whether very mild Dementia could also fit into this level.

According to Ganguli (2006), the Mayo Clinic has five criteria for diagnosing patients with MCI: memory complaint, memory deficit, normal mental status, absence of functional impairment, and absence of dementia. Ganguli also discusses a particularly relevant debate over whether neuropsychological tests alone can predict occurrences of Dementia or whether a diagnosis should also include memory tests in addition to the clinical scores. Others debate whether normal cognitive function with the exception of memory loss should be inclusive or exclusive of a MCI diagnosis (Ganguli 2006). In

other words, some believe that MCI patients are perfectly able to go about their day-to-day lives without change or limitations. Others believe that the cognitive decline associated with MCI includes cognitive functionality necessary to complete tasks of day-to-day life.

As mentioned earlier, Mild Cognitive Impairment is neither an end nor a beginning. When there is no obvious cause (such as a stroke or BTI) the occurrence of MCI may not necessarily be characterized by a stable, low-level of cognitive function, therefore a static diagnosis that takes only into account the result from a test performed in an isolated instance may not provide an accurate result. Artero and Ritchie (2003) argue in favor of a multi-faceted approach. In addition to the clinical tests, they argue that general practitioners should also get confirmation from someone with a relationship to the patient. This person, labeled as the "proxy" by Artero and Ritchie (2003), should be able to confirm that cognitive decline in the patient has occurred during a twelve-month period preceding the test. Morris et al. (2004) endorse this recommendation by including the spouses of MCI patients in their study of social interactions and needs among those with cognitive decline. Ganguli (2006) concurs by suggesting that there should be a reliable informant when there is a complaint of memory loss. Evidence suggests that an identifiable decrease in cognitive ability over a period of time is helpful in diagnosing a patient with MCI.

Mild Versus Extreme Cognitive Impairment

The terms "cognitive impairment" and "cognitive decline" apply to Alzheimer's Disease, other forms of Dementia, and to certain stages of Parkinson's Disease in addition to Mild Cognitive Impairment. Therefore, a discussion of the various

differences in cognitive function among these different illnesses is warranted. The

Clinical Dementia Rating and the Global Deterioration Scale models provide a severity

level system for measuring cognitive decline, thus these illnesses can be assigned to such

levels accordingly. Alzheimer's Disease and other forms of Dementia tend to be

classified in the last three levels of the CDR and in the last four levels of the GDS.

Level four (of seven) of the GDS describes the patient as suffering from a "clear-cut

evidence of memory deficit during interview with clinician, including decreased memory

of current and recent events, decreased ability to travel or handle finances, inability to

perform complex tasks. Patient may also deny there is any problem with his/her memory

even though it is evident to friends and family" (Global Deterioration Scale 2006).

There is debate as to whether MCI affects a patient's ability to carry out tasks

associated with daily living. One possible source of a solution to this debate is to use an

aggregate diagnosis based on a list of daily functions and to see if the patient has

noticeable decline in performing them. In other words, perhaps a patient may meet X

number of the criteria listed above for Level 4 of the GDS, which would then move the

patient from a diagnosis of MCI to any of several other diagnoses that correspond to this

level. Conversely, if a patient fails to meet X number of the criteria, then the patient has

not yet progressed past level three. Patients at level three of the GDS "may have gotten

lost when traveling to a familiar location; may forget familiar names, may have problems

finding the correct word; family and/or co-workers are aware of memory lapses; patient

may have lost or misplaced an object of value; patient may show anxiety and/or deficits

in concentration" (Global Deterioration Scale 2006).

Artero and Ritchie (2003) conducted a study of MCI patients versus cognitively normal patients across a range of daily-life tasks. They then separated the results of the MCI subjects into two groups based on whether the subjects were eventually diagnosed with Dementia. The percentage of those who had difficulty with each task was almost always higher with the MCI subjects who were eventually diagnosed with Dementia. Nearly 53 percent of subjects in this group reported having difficulty with at least one daily task versus just over 29 percent of MCI subjects who were not. The largest disparities in daily functional abilities were noted for dressing, putting on shoes, use of phone, and bathing. This study suggests that different causes of MCI (precursor to Dementia, Vascular Disease, etc.) may cause MCI to present itself with varying levels of severity and restriction. Another explanation, mentioned by Ganguli (2006), is that 20 percent of those diagnosed with MCI already have Alzheimer's Disease. In any case, MCI is not a homogenous illness and its symptoms are not uniform in severity.

Lu et al. (2005) conducted a study of Iconic Memory in patients with clinically-diagnosed Mild Cognitive Disorder, and the results seem to conform to level three of the GDS. Iconic Memory refers to a person's ability to store and retain visual images in his or her short-term memory, and Lu's study attempts to discover whether the Iconic Memory of patients with MCI has a faster rate of decay. Lu's study was, in part, motivated by an earlier study of Iconic Memory (Yang 1999) in which one subject became an outlier due to the unusual rate of his Iconic Memory decay. In the earlier study, the outlier who had the short Iconic Memory eventually went on to develop Alzheimer's Disease; thus it is possible that such short Iconic Memory may be a warning sign or a precursor to full-blown Dementia.

Lu et al. (2005) conducted the experiments using three groups: an experimental group of patients diagnosed with Mild Cognitive Impairment; a control group of cognitively normal people within the same age range of the experimental group; and a group of undergraduate college students.   They used the Clinical Dementia Rating scale score of .5 to screen subjects into the experimental group. After completing the experiment, Lu et al. found that the Iconic Memory of MCI patients may indeed have a faster rate of decay than that of similarly-aged, cognitively normal people. The results provide at least one possible symptom that distinguishes MCI from other neurological memory disorders. While the rate of memory decay of the experimental group participants was faster, there was no difference in the ability of MCI patients to transfer visual icons into short-term memory initially. In other words, the ability to store information into short term memory may not be diminished by MCI; only the length of time that patients have recall of such memory is diminished. This may set MCI apart from Alzheimer's and other forms of Dementia.

Cognitive Impairment and the Internet

Several studies have linked cognitive decline with difficulties in Internet usage. Greger et al. (2002) asserted that age and its associated memory impairment and visual impairment can make it more difficult for people to understand and process visual clues and contexts. In mentioning the issue of context, they began to link memory decline with Internet usage ability. Because the Internet (and specifically the Web) requires navigating through layers of pages, a conceptual understanding of one's location within a given Web environment is crucial. If memory impairment (a key symptom of MCI)

affects one's ability to successfully navigate through the framework of a given website, then there is reason to believe MCI would have a similar and perhaps stronger effect.

Czaja (2005) takes Greger's assertion a step further, writing that, "Several studies… have shown that cognitive abilities such as working memory, attention and spatial abilities are important predictors of performance of computer-based tasks" (Czaja 9). While she then discusses age-related changes in cognition, her assertion that working memory may impact performance of computer-based tasks shows again that MCI could produce a similar impact. As discussed earlier, the Iconic Memory of patients with Mild Cognitive Impairment decays more rapidly which in itself is a part of one's working memory. Gugerty et al. (2006) add that cognitive functions necessary to successfully use the Internet may also be diminished by other impairments from which an older person may suffer. Older people may be dealing with a limited amount of cognitive ability with which to overcome several obstacles such as visual and motor-reflex impairments, which then leaves little cognitive capacity left to put towards successfully orienting one's self within a given Internet environment. That bank of cognitive ability may be further depleted by Mild Cognitive Impairment.

There may also be a vocal counterpart to Iconic Memory, in which short-term memories of vocal stimuli would reside. Greger et al. (2002) proposed a solution for cognitively impaired users that would implement a piece of software called BrookesTalk in order to verbalize some of the aspects associated with browsing the Web. This piece of software would prompt users upon startup to select from several different options using the Function keys at the top of the keyboard. The users could then have the options

repeated to them as necessary. The idea here was to give users more confidence in their abilities to manipulate the system.

Greger et al. (2002) implemented the software to test the usability of the audio enhancements. While their test group of older people did not separate those with age-related cognitive decline from those with cognitive decline beyond age expectancy into groups, the results show a difference between the older test group and a younger control group with respect to their abilities to handle longer audio instructional statements versus shorter ones. The older test subjects were confused when given extra information contained in the longer audio instructional statements. The researchers were attempting to study the effects of age on the usability of BrookesTalk, though it may have been more useful to separate the older experimental group into groups based on cognitive function in order to get at the underlying causes. This would have been particularly useful, given that the results for the older group varied.

Gugerty et al. (2006) offer a different approach. Rather than implementing a piece of software to make the current Web more accessible, perhaps interfaces should be redesigned to accommodate people with differing levels of cognitive ability. Kurniawan et al. (2005) came up with a set of guidelines to aid designers in creating interfaces suitable for older people. Of the many guidelines presented, those that attempt to mitigate the effects of cognitive decline are most useful here. The relevant guidelines are as follows: "Icons should be simple and meaningful"; "Extra and bolder navigation cues should be provided"; "Clear navigation should be provided"; "Provide location of the current page"; "Avoid pull down menus"; "Do not use a deep hierarchy and group information into meaningful categories"; "Avoid irrelevant information on the screen";

"Important information should be highlighted"; "There should be differentiation between visited and unvisited links"; and "Reduce the demand on working memory by supporting recognition rather than recall and provide fewer choices to the user".

Conclusion

According to the literature reviewed above, even mild cognitive impairment can have an impact on one's ability to successfully use the Internet. Web designers may choose to follow certain guidelines when building websites in order to accommodate for cognitive decline, and software programs designed to ease the burden on working memory can help combat the effects of cognitive decline for such users. Different causes of cognitive impairment may also result in different levels of ability when using the Internet, even if some of the more general effects are classified under the umbrella term Mild Cognitive Impairment.

There exists a gap in knowledge of how cognitive decline, beyond what is expected for age and education level, affects a person's ability to successfully use the Internet. Previous studies have focused on the challenges of using the Internet brought on by the physical effects of aging, and studies have included observations of age-expected levels of cognitive decline. However, research is sparse in the area of mild levels of cognitive decline that are greater than expected and their effects on Internet usability. This study attempts to discover some of the challenges imposed on Internet users who fall into this category in hopes that the results will lead to greater awareness of these challenges when designing websites.

METHODS

Regular users of the Internet who have experienced mild cognitive impairments were recruited from local retirement homes, public libraries, and places of worship. Interviews and observations of Internet use were then conducted, and transcripts of the sessions were produced. The transcripts were then coded inductively, based on categories of Internet-related challenges expressed by the participants, and recommendations for better web design practices were produced based on those categories. These study methods are described in more detail below.

Population, Sample, and Sampling Technique*:*

The total population of interest for this study includes all individuals who are afflicted with Mild Cognitive Impairment and other cognitive impairments of similar natures and severities. The population includes both those who have actually been diagnosed with cognitive impairments and those who have such illnesses but have remained undiagnosed. The population includes persons of all races, religions, socio-economic backgrounds, genders, and sexual orientations. Furthermore, this population includes persons who are single, married, partnered, and widowed.

Because the importance of this research is based on the predicted increase in the percentage of people in the United States who are over the age of sixty-five, the relevant population for this research was limited accordingly. Furthermore, the relevant population was limited to those who are currently using the Internet or who have used the Internet with some frequency within the six-month period preceding each interview.

A convenience sample was recruited from this population. It consisted of seven participants who fit the population description above and are over the age of sixty-five. Participants were also required to speak fluent English. Spouses, partners, and caregivers were also interviewed when possible. Such caregivers were interviewed separately from the primary participants.

Participant Recruitment

Participants were recruited from several locations in Chapel Hill, Carrboro, and Durham. Participants were recruited through several of the local retirement communities including The Cedars of Chapel Hill, Carol Woods, Carolina Meadows, and Croasdaile Village. Fliers (see Appendix A) were posted in the main club houses at each community, and presentations for the study were given at Carolina Meadows and Carol Woods.

Participants were also recruited through the Chapel Hill Public Library, the Carrboro Branch Library, the Carrboro Cybrary, and the Durham County Public Library-Main Branch. Fliers were posted on the Community Announcements bulletin boards in each of these locations. When possible, fliers were also posted near the public-use computers in each location. Fliers were also posted at the Chapel Hill Senior Center. Announcements were also included in the newsletters of local churches and synagogues when possible.

Potential participants contacted the principal investigator on a volunteer basis. Each potential participant was then asked a series of questions to determine eligibility (see Appendix B). Once potential participants were determined to be eligible to participate, they were asked if they had spouses, partners or caretakers that would like to

participate. If so, the participants were asked for permission to request an interview with said companions. The participation of the spouses, partners, or caregivers was optional.

Once participants agreed to take part in the study, they were presented with the opportunity to have a ten-dollar donation made to the charity of their choice, paid by the investigator. The participants were given the choice of having this donation made anonymously or in their name. There were no restrictions placed on where the participants chose to send their donations, and all but one of the participants took advantage of this incentive. The donations were made after the completion of the study.

Description of Data Collection Instruments

Once participants had given their consent (see Appendix C) to be included in the study, three instruments were employed for data collection purposes. The first instrument was an interview schedule (see Appendix D). This interview schedule contained a list of questions that were asked during the interview. The questions were divided into two groups based on the person to whom they were asked. The first group consisted of questions asked of the primary participants, and the second group consisted of questions that were asked of the companions.

When necessary, notes were taken during the interviews. Taking notes provided a record of some of the nuances of the interviews that may not be apparent in recordings or transcripts, and such notes were used to highlight important points and thoughts that aided in the final analysis of the data. Each interview was recorded with a mini-audio cassette recorder, with the permission of the study participant.

In addition to the interviews, participants were asked if they were willing to be observed during their use of the Internet (see Appendix E). Participants were asked to

repeat a recent experience with a component of the Internet. Participants were then asked to complete another task not of their choice. They were asked to use the website for the United States Senate in order to write an electronic letter to the U.S. Senator from North Carolina, Richard Burr. This observation method added another perspective on the difficulties that each participant faces.

During the observation session, participants were asked to think aloud (van Someren, Barnard & Sandberg 1994), verbalizing their feelings and thought processes. This method allowed for the collection of data relating to each participant's state of mind while performing the tasks. If the verbalization stopped, participants were reminded to continue thinking aloud. As with the formal interview, the think-aloud protocol was captured with an audio recorder.

The recorded interviews and observation sessions were then transcribed by the principal investigator. Transcriptions were used to provide data without the emotions and inflections of the participants. Transcriptions were stripped of all identifiable information, including names of the participants or of the participants' spouses, partners, or caregivers and any other contact information initially given.

Ethical Dilemmas

Several ethical dilemmas present themselves regarding this particular research topic and research method. The most important of these ethical issues concerns the mental state of the participants. These participants suffered from various levels of cognitive decline which had the potential to pose problems in eliciting clear and coherent answers to my questions. This required further probing, and was conducted in a manner

that was intended to produce the information sought while also keeping the participant at ease.

There was also the potential for disagreement between the participant and his/her spouse, partner, or caretaker. This disagreement could play out within two possible scenarios. The participant may be more optimistic about his/her Internet skills than is his/her companion, or the companion may be more optimistic than the participant is. For the participant, he/she may be hurt if the companion makes an assessment that is worse than what the participant expected. This could worsen any illness-related depression from which the participant may already be suffering. Conversely, the companion may have been convincing him/herself that the participant is better off than is actually the case. This realization could potentially be a shock for the companion, and was avoided in this study. All primary participants were interviewed without the presence of their spouses, though it should be noted that this was a result of the circumstances surrounding each interview, rather than a result of the design of this study. In each case in which the participant had a companion, the companion was simply not present for the interview.

Data Analysis Techniques

An open coding method was used to analyze the data produced by the interview and observation transcripts. Transcripts were coded for recurring themes and issues mentioned by the participants during the interviews and observed during the observation sessions through the think aloud protocol, resulting in a single coding scheme applied to all transcripts upon completion.

The questions asked of each participant covered several different areas of Internet usage, such as email, information searches, news, and chat/instant messenger. The

coding system was not developed in advance of beginning the data analysis. It was deemed important for the data collected to shape the coding system in order to ensure that the responses given by the participants would then shape the results of the research.

One note of importance is that the components of the final coding system were compared with obstacles faced by elderly users that are caused by forces other than cognitive impairments. Instances in which there is significant commonality were identified and eliminated.

Advantages and Disadvantages of this Research Method

The strength of qualitative data collection lies in its ability to illuminate one's understanding of a particular situation or set of circumstances to a level of depth unattainable by other research methods (Babbie 2004). Understanding the issues as completely as is possible is a critical component necessary to completely identify the effects of cognitive impairment on one's ability to successfully use the Internet.

Unlike other research methods, conducting interviews allowed for some flexibility in the types of questions that were asked of the participants. Interviews allowed for a certain level of customization based on the participants' responses. Follow-up questions were asked, and points of clarification were made when necessary. Because the interviews were governed by a guide with possible questions rather than a list of required questions, the principal investigator was able to adjust and alter questions that were not garnering data in the earlier interviews. For this study, the interview questions remained largely unchanged, but in cases where participants had already answered a particular question in his or her response to a previous question, there was no need to have the participant repeat the information. As an example, some participants answered question

5, on particular aspects of Internet use (see Appendix D), while answering question 4, a more general question about the participant's Internet use. Other participants stated that they were not using Chat or Instant Messenger, which rendered asking question 7 (about difficulties experienced in using Chat) unnecessary.

Conducting the observation sessions allowed the principal investigator to witness the frustrations and the obstacles that these Internet users faced firsthand, as they occurred, rather than relying on participants' recollections (Babbie 2004). This ability provided an increased level of validity because actual observation of the phenomenon in question was made possible. Conversely, a single investigator made the interpretations of these frustrations and obstacles which may have hindered reliability, and there was no guarantee that another observer would not have interpreted similar events or occurrences in a different manner. Thus this is a descriptive study, rather than a conclusive study.

One important disadvantage of the interview method with regards to this particular topic is that much of the data was produced primarily from the memory recall of persons afflicted with a cognitive impairment. While Mild Cognitive Impairment may or may not have an impact on one's long-term memory, studies have shown that it does impact short-term memory. This deficit may have caused participants to provide incomplete answers to the questions asked in the interview. This memory deficit may also have inhibited participants' abilities to recall some of the obstacles they face when using the Internet. Furthermore, the use of the think aloud protocol (as previously mentioned) takes up some of the capacity of one's working memory (Someren 1994) . This memory resource may already have been in short supply for these participants.

Another disadvantage to this method of study is that the results may not be generalizable when tested across the entire relevant population. This is a descriptive study based on the experiences of seven people, thus the results do not represent broad generalizations across the entire population of people afflicted with MCI or other, similar cognitive impairments. The value in conducting interviews and observation sessions in order to fully understand the challenges and obstacles faced by this particular group of Internet users outweighed the disadvantages of decreased generalizability.

RESULTS AND DISCUSSION

In spite of the limitations of the study methods, it did yield useful results on the challenges that this particular group of Internet users faces. The majority of the challenges that surfaced were related, in some way, to the design or accessibility of websites. Other challenges included problems with performing successful information searches using Google and obstacles in taking advantage of email capabilities, such as attaching and sending files. After an overview of the participants' characteristics, each challenge is discussed in detail, referencing the individual problems experienced by each participant.

The Participants

Seven participants took part in this study. All seven participants lived in local retirement communities and were recruited from posters placed in and presentations given at those communities. Three of the participants were male and four were female. Their average age was just over 82 years; the youngest participant was 79, and the oldest participant was 86. Three of the participants lived alone, four lived with their spouses, and all participants lived in the Independent Living sections of their communities. Six of the participants had high-speed Internet access in their homes, while the remaining participant only used the Internet in the computer lab in his/her community. All except this last participant agreed to participate in the optional observation session.

The companion interviews were optional, and only one companion of one participant consented to be interviewed as such. Another participant chose not to consent

to having his/her companion interviews.   The final two participants who were married were married to each other, so both of these interviews were considered to be primary interviews rather than companion interviews.

Failed Information Searches

Three of the seven participants expressed troubles and/or frustration when performing information searches. One participant particularly noted problems when using Google to conduct such searches, and stated that he/she never thinks of how to perform searches in ways that would maximize the potential of the particular search engine being used. In other words, the participant believes he/she doesn't think in the same way that Google does when approaching a given information need. The search terms entered by the participant may not match up with the search terms indexed by Google that correlate with web pages relevant to the information need.

Another participant described similar problems in finding relevant information for a particular information need. However, this participant blamed the extensive and overwhelming number of results displayed after executing a search. He/she does not necessarily blame the terms entered into the search box at the beginning; rather the participant has a hard time navigating through the massive number of results. The participant explained that he/she will often begin by reading the first result rather than looking around to see if any of the other results may actually have more relevance to the initial information need. Because the participant is aware of the need to look at some of the other results either before or after reading the first one, and yet fails to do so, this may be a symptom of lowered working memory. The participant may be getting lost within the first result, thus he/she is forgetting to check the other results.

A third participant described a very specific information search he/she attempted to execute without success. The participant was trying to find a specific website, but he/she did not initially have the exact web address. Therefore, the participant tried to find the website using a search engine, but had no success. He/she said the results contained websites that had similar names to what he/she was looking for, but there were no exact matches. The participant was eventually given the correct address from a relative and was able to load the correct website, but then he/she had trouble finding what he/she was looking for within that site. The site contained links to news articles, with the first few sentences of the articles underneath them, but he/she was unable to figure out how to retrieve the full text of the articles. Because this participant had been successfully using the Internet for several years before his/her memory problems began, these difficulties may be a result of cognitive decline.

Difficulties Making Travel Arrangements

Two of the seven participants cited problems and/or frustrations when trying to book travel arrangements online. Both of these participants attempted to step through this process for the first task during the observation session, and both had troubles with various aspects of doing so. The specific travel website chosen by each participant was unique; however the troubles encountered are problematic for several of these travel websites.

One of the participants successfully arrived at the flight search page for the particular travel site he/she was viewing, but then ran into trouble. The participant complained that he/she could not remember the right 3-character airport code for his/her destination. And to compound this problem, the participant entered in the full name of

the wrong destination airport. He/she wanted to travel to destination A but was confused about the name of the airport at destination A and put in the name of another destination, destination B. The participant eventually did remember the correct airport name, but there were two forces working against him/her. The first is that some of these travel sites do not automatically search for the correct airport name or code based on what the user begins to type, and page links to listings of the correct codes are not always clearly visible. The second is that users in this population may not eventually remember the correct name as the participant did, which means that a user could book and pay for a flight with an incorrect destination. Both are possible results of memory and/or cognitive impairments.

The other participant had problems with selecting the desired dates for his/her travel plans. The participant was using a travel site that employs drop-down menu options for date selections and was having difficulty selecting the desired dates. These difficulties may have resulted in a lack of understanding of how best to select the appropriate dates from the menus, thus this participant's troubles may not be related to memory or cognitive impairments. It is possible, however, that the participant has forgotten how to correctly select these menu options, a task he/she may have executed more quickly before his/her memory problems began.

Difficulties Locating Desired Links

Of the six participants who took part in the optional observation session, five had varying levels of difficulty recognizing and locating the "Contact Senator Burr" link when attempting to locate the Senator's web email form. The link is displayed prominently on the left-hand side of the page, thus it is significant that a majority of the

participants were unable to recognize and/or locate it. Some of the difficulties encountered with this step of the task may be symptomatic of memory impairments, while others may have more to do with a lack of sufficient knowledge of web semantics.

Of these five, one participant located the link very quickly, but determined that this was not what he/she was ultimately looking for. Underneath the "Contact Senator Burr" link, there is another box containing a form by which users can sign up for Senator Burr's E-newsletter. The participant began entering his/her email address, possibly thinking that this would allow him/her to email the Senator. Another participant began to do the same, but then concluded that this was not going to help him/her finish the task. Mistaking this E-Newsletter box as a means to contact the Senator may be the result of a decrease in cognition levels; alternatively, it may be that the confusion was caused by a lack of experience with forms on the Internet.

The remaining four participants failed to locate the "Contact Senator Burr" link for various other reasons. Senator Burr's home page has a dominant horizontal navigation bar, and most of the participants began searching there when trying to find the contact link. One of the participants even found a link called "Email Me" located in a drop down underneath the "About Senator Burr" link in this bar. But the majority of the participants did not initially pay attention to the large links located on the vertical, left-hand navigation bar. After failing to find the appropriate link in the horizontal navigation bar, two participants scrolled down in their pursuits, eventually reaching the bottom of the page. One of these two participants found a link at the bottom called "Contact Me"; the other did not. It is not clear whether these difficulties were undeniably related to any memory impairments, though the investigator repeated the phrase, "Contact Senator

Burr", several times when participants were having troubles. All participants were able to successfully complete this part of the task on the second try.

Scrolling Down in Search of Information

Several of the participants had minor problems with using the scroll bar to view contents of websites not immediately visible. The majority of the participants who took part in the observation session did not scroll to the bottom of Senator Burr's "Contact Me" page where the actual form is located. The page lists the Senator's contact information, such as the addresses and telephone numbers of his offices, towards the top which pushes the actual form down below the fold. Some participants tried to locate Senator Burr's email address within the contact information listed, but no email address was given in this location on the page. This may have caused some confusion for some of the participants, as they were instructed to find a way to write an "electronic" letter rather than send a physical letter or make a telephone call.

These difficulties may be the result of a poorly designed website, but another factor may hold a more accurate explanation. The link titled "Contact Senator Burr" may not be intuitive for users in this age group. Do users of this age group necessarily think of Email as a means to contact a person in the same way they might think of writing a letter or making a telephone call? When such a user wishes to contact a person, at what point does the thought of sending an email cross their minds? A knowledge gap may be the culprit for those participants who did not locate the actual form and did not try to search for an email address listed in the contact information at the top.

One participant displayed similar troubles when stepping through the first task of the observation session, a task of the participant's choosing. The participant was entering

information into a form on a website but was having difficulty locating the button to submit said information. He/she looked across the entire visible portion of the page, but the button was located slightly below this portion. The participant did not attempt to scroll down to find the button until suggested to do so by the investigator after an appropriate amount of time had passed. This problem, in combination with the problems related to the Senator's contact page may signify a larger issue with respect to scrolling among this group of users. Some of these participants may not always remember that these sites have more content than what is immediately visible.

Too Much Information and Too Many Options

Three of the seven participants either reported difficulties in dealing with the abundance of information presented to them when visiting websites or experienced such difficulties during the observation session. One participant had complained that the amount of information available was just too much to handle, and has subsequently reduced his/her time spent on the Internet. The participant felt that he/she had to go through all of the information presented on sites too quickly, thus neither comprehending nor processing all of it. This participant has become more reluctant to turn to the Internet to find information he/she is looking for.

Another participant found an alternative navigational path to take when stepping through the second observational task and commented on a more general problem with too many choices and ways to find what he/she is looking for. This participant located the search box on the U.S. Senate homepage before he/she located the "Senators" link, which had been the expected method of choice. The method taken by this participant was not the most efficient path to take, and he/she indicated that he/she sometimes has trouble

finding alternative, shorter paths towards a given goal. This participant also displayed

trouble finding certain pieces of information in the first observation task and indicated a

sense of overall confusion when trying to advance to the next step in the chosen task.

The third participant cited difficulties sifting through long lines of links when

trying to locate the one that will take him/her to what he/she is looking for. The

participant said he/she will sometimes go all the way down the list (referring to typical,

left-hand vertical navigation bars) without finding any link that seems appropriate for the

task at hand. This participant had a similar problem during the second observation task

when trying to step through the second task again and started focusing on trying to

choose a particular class of senators. In essence, this additional parameter was not

needed for the task, yet the participant believed otherwise.

Search Boxes vs. Address Bars

Two of the participants who participated in the observation session displayed

difficulties in distinguishing the difference between the address bar near the top of a

typical web browser and a search bar located on the participants' respective home pages.

One of the participants entered in the correct address for a website he/she wanted to show

the investigator, but did so in a search bar instead of the address bar. The participant then

clicked the "search" button, and attempted to sift through the results displayed. He/she

found a link that looked like it might have taken him/her to the homepage of the

particular company, but the link actually directed the participant to an interior page

within the site. Upon completion of the task, the investigator introduced the participant

to the address bar, and the participant said he/she had not previously been aware that web

addresses work best when typed into the bar at the top. There was no evidence at the

time of the interview to suggest otherwise. This participant's troubles may be the result of insufficient education in how to maximize the potential of a typical web browser.

The second participant had similar problems when beginning the second task of the observation session. He/she was instructed to type in the web address for the U.S. Senate homepage and proceeded to do so in a search box located on the homepage rather than in the address bar at the top. The participant had shown the investigator a website earlier in the interview, though the website was linked in an email. This participant did not express surprise when shown the address bar, whereas the previous participant claimed not to have prior knowledge of its functionality. Furthermore, the search box on this particular homepage was near the top of the browser window, not far below the actual address bar. The location of the search box may have caused some confusion for this participant, and because both participants suffer from memory problems, both may not be processing the minute differences in the varying functionalities of the two.

Keeping Track of Usernames and Passwords

Three of the seven participants mentioned trouble with usernames and passwords for websites they visit frequently. One participant manages his/her investment portfolio online and was having trouble accessing the account. Repeated attempts at entering the username and password failed, and this problem continued for several days. The participant insisted he/she was entering the correct information, and eventually called the investment firm to rectify the situation. No evidence was presented at the time of the interview to suggest either that he/she was entering the wrong information or that the firm was having technical glitches with its login interface. Thus, no conclusion as to whether

this participant was entering an incorrect username and/or password due to memory problems can be reached.

Another participant was having trouble accessing his/her email account through the email provider's web interface. The participant had had this particular email account for some time, and recently had been unable to access it. During the interview, the participant explained that the email provider had changed his/her email address to include characters not previously present in his/her email address. No evidence was presented during the interview to either confirm or refute his/her explanation, so no conclusion can be drawn as to whether the email provider is to blame for this particular obstacle. The participant also tried to create a new email address with the same provider but was having difficulty locating the appropriate sign-up page to do so.

A third participant had trouble remembering his/her email address. In the interview, the participant had stated that his/her spouse (with whom the participant shares the email address) had changed the address several times. The participant was having difficulty keeping up with these various changes, and this was preventing him/her from accessing the email account. His/her experience brings up a more general problem with remembering usernames and passwords for the multitude of secured websites that typical users visit. Another participant stated that he/she writes down such information rather than relying on memory.

Discussion

The problems experienced by the participants centered on trying to take full advantage of different websites that they visited, either on their own or as part of the observation session. Challenges included performing successful information searches;

locating desired links when browsing web pages; and entering in correct information when making travel arrangements. Other challenges included sending attached files in an email letter and keeping track of user names and passwords for email accounts and financial accounts accessed online. None of the challenges presented in this study can be traced back to existence of Mild Cognitive Impairment with absolutely certainty, the symptoms of MCI are consistent with many of these issues. From feeling overwhelmed by the amount of information presented on a website to forgetting necessary information when making travel arrangements, many of the issues presented in this study may be caused by issues relating to a decline in cognitive abilities.

RECOMMENDATIONS FOR WEBSITE DESIGNERS

The resulting recommendations from this study were constructed from the challenges faced by the participants. In some cases, the categories of challenges have been groups together according to the recommendations made here for improvements. Said recommendations are explained and put into context with respect to previous research, and then lists of steps that web designers can take are then provided. And some of the recommendations presented here are currently being implemented, independent of any knowledge of this study on the part of current web designers.

Improvements to Search Engines

One of the areas in which the several of the participants had difficulties relates to the process of searching for information and sorting through the results. There was a general feeling of being overwhelmed by the number of results from a search, thus the participants described their difficulties in finding exactly what they were looking for. In light of these findings, search engine companies should consider redesigning the user interfaces for their engines in the following ways:

1. Eliminate the sponsored links and advertisements. These tend to be displayed at the top of the search results, off to one side, or both. In some cases, these layouts may result in a greater level of confusion for these participants, especially when results appear in more than one column on the page.

2. Consider taking out the actual URL for each search result. This URL is displayed in green type-color at the bottom of each result in the Google, Yahoo, and MSN search engines. Because the titles of the search results are linked to the pages themselves, the URL listed below is redundant and takes up space.

3. In place of the sponsored links, consider adding suggestions on how to refine a search to narrow the results. Such methods include the use of plus (+) and minus (-) operators and the use of quotation marks to denote phrases. These instructions could replace the right-hand sponsored links.

Repositioning Search Boxes

Two of the seven participants confused search boxes that were prominently placed on certain websites with the address bar located near the top of commonly-used web browsers. These search boxes were elongated to lengths rivaling Google's search box, and because these search boxes were being placed near the top of these sites, their proximity to the address bar at the top of the window was too close. The two participants confused the purposes of the two text boxes.

Both MSN and Yahoo have these types of search boxes near the top of their respective homepages. It is the recommendation of this study for both companies to relocate and resize their search boxes in order to mitigate the confusion experienced by these users. However, if both companies are determined to keep their search boxes in their current locations at the top, the web designers should consider reducing the size in order to draw a sharper contrast between the search boxes and the browser's address bars.

In addition to reducing the size of the search boxes, it is recommended that the search box be relocated to the top, right-hand side of the homepage, rather than in the top, center of the page. Those users who desire to use the search box for its intended purpose can still do so, as the box will still have a prominent position on the page. Moving the search box to the right will provide a clearer contrast from the address bar that spans most of the width of the browser window. This relocation should ultimately reduce the confusion these participants experienced when trying to type a URL into a search box rather than the address bar.

In summary, it is recommended that:

1. The size of the search box be reduced, in order to avoid confusion with the browser address bar.

2. The search box be relocated to the top, right-hand corner of the page.

Improved Display of Information and Links

Previous research suggests that the optimal number of links for a navigation bar is somewhere around 6 or 7. This is a reasonable recommendation that should be implemented, if not across the board, then at least in websites geared toward senior citizens. Kurniawan and Zaphiris (2005) have also shown that using strictly textual links, rather than image links, allows the population of elderly users to keep track of the links they have visited before, assuming that web designers do not override the "visited links" design property. This is not possible when using image links. The results of this study are consistent with these earlier findings and recommendations.

Kurniawan and Zaphiris (2005) have argued in favor of breadth versus depth when creating navigational structures for a website. In other words, allowing for a

greater number of options on the home page then reduces the number of layers needed for internal pages or pages not immediately accessible from the homepage. The results of this study show that, for the majority of the participants, the presence of too much information and/or too many links can be confusing. Further, some of the participants failed to take advantage of both the horizontal and vertical navigation bars located in the pages visited during the second task.

The recommendations for the overall display and the display of links are as follows:

1. Use either a vertical navigation bar at the top or a horizontal navigation bar on the left-hand side. Do not use both.

2. Group pages into meaningful categories that can be accessed from the homepage rather than provide links to all individual internal pages.

3. Use only textual links when possible. Refrain from using image links.

4. Limit the number of links given in a navigational bar to 6 or 7.

5. Display all important information above the fold in a 1024 by 768 pixel display resolution.

Improvements to Travel Sites

With the increasing popularity of travel websites such as Orbitz, Travelocity, Expedia, and PriceLine (not to mention the airlines' sites), booking travel arrangements online has become the preferred method for many users. Two of the seven participants had various difficulties with these types of sites and, since mistakes while using such sites can be quite costly, recommendations for improvements to avoid such mistakes are necessary.

One of the participants had particular trouble remembering the destination airport name and 3-letter code for his/her travel plans. It is possible that, had the participant not eventually remembered the correct name, he/she may have booked a flight to the wrong destination. And since flights booked on these sites tend to have restrictions in terms of cancellations, refunds, and changing itineraries, the participant most likely would have had to pay an additional fee to fix the destination airport mistake. Taking this argument a step further, it is possible that the participant might never have realized the mistake which would then increase his/her chances of actually boarding the wrong flight on the day of travel.

To help counteract these potentially costly problems, travel websites should implement a strategy that better ensures that the correct departure and arrival airports are entered. For example, U.S. Airways, in revamping its website in 2006, added a new feature to the form boxes for the departure and arrival airports. As a potential customer begins typing in the name or 3-letter code of the airports, a little pop-up window appears that enacts a script (possibly a PHP script) that searches the database of airport codes and returns matching codes. This list is then narrowed as the user continues to type, and the user can either choose to finish typing in the name or code or select the correct option (with city listed) from the popup box. All travel sites would benefit from such a system.

Here is a list of recommendations:

1. Consider implementing a database-driven system similar to the system U.S. Airways recently implemented that allows for easy access to the correct airport code for a given destination.

2. Have an automatic pop-up calendar for the date-entry boxes. Orbitz employs such a feature. This helps avoid problematic pull-down menus and gives users dates in a calendar format.

3. Simplify initial flight search pages and provide a link to a more advanced search page for users with complex travel arrangement needs.

Getting Rid of the Clutter

Three of the seven participants expressed or displayed problems dealing with the abundance of information presented on certain websites. These participants displayed a sense of bewilderment at the vast contents of information available from some of the websites they visit, and such bewilderment has become a real barrier for making strides towards a higher level of usage for at least one of these participants. Websites need to be informative; however web designers must also take into consideration that certain users will have more difficulties in digesting and processing all of the information they are seeing.

Perhaps the most effective recommendation for de-cluttering a website is to focus on increasing the amount of whitespace. In addition to helping those with vision problems and limitations, this will force the designer to arrange the text and information in a more coherent manner. This is achieved by encouraging designers to better organize information into recognizable groups, using increased whitespace as the group borders. This approach may not work quite as well for websites containing single blocks of text, but sites containing text that can be so grouped, will benefit from increased readability and navigability.

CONCLUDING REMARKS

The risk of suffering from Mild Cognitive Impairment increases with age. Artero and Ritchie (2003) estimate that cognitive decline may be present in as much as 50 percent of the population over 65 years of age, based on self-submitted complaints. Gauthier et al. (2006) also claim that MCI afflicts a large percentage of those who are over 65 years of age. In addition, Gauthier and his colleagues note that behavioral components such as anxiety, depression, irritability, and apathy may also stem from cognitive decline.

The United States population of people over 65 years of age is approximately 13 percent of the total population, and that statistic is expected to grow to 22 percent by the year 2030 (Czaja 2005). As the Baby Boomer generation begins to enter this demographic, an increase in the total number of persons afflicted with MCI and other cognitive impairments is likely. As people age, their abilities to perform physical, sensory, and cognitive functions begin to vary in comparison to their demographic peers (Greger et al. 2002). Some of these variances are associated with age, though others may be caused by illnesses such as MCI. Understanding how individual differences affect a person's ability to effectively use technology will allow for designers of interfaces to make accessible their interfaces to a larger percentage of the population (Gugerty et al. 2006). This statement could be extended to include a larger percentage of the "aging" population.

As the percentage of the population over 65 years of age increases, the importance of assessing and understanding the needs of this demographic group will also increase. Morris et al. (2004) conducted a qualitative study of the social needs of elderly people with various levels of cognitive decline. The study concluded that there are three main goals of social interactions for this demographic group: reciprocity; diversity; and extensiveness. Of these three, the latter two are most relevant to understanding how such people can interact with and benefit from using the Internet. The Internet can provide a new venue for socialization (Kurniawan & Zaphiris 2005). Using the Internet to form and maintain diverse and extensive social connections can help people with cognitive decline feel less isolated. Czaja (2005) also notes that understanding the technological needs of this user group and then designing or redesigning interfaces to meet those needs will help such users to have a better quality of life.

In addition to the predicted increase in the population over 65 years of age, this age group represents one of the fastest growing groups in terms of Internet usage (Kurniawan & Zaphiris 2005). One key difference that sets this generation apart from its predecessors is the widespread use of the Internet. If this is true, and if the risk of developing Mild Cognitive Impairment does indeed increase with age, then the United States may very well see an increase in the number of cognitively impaired people who are using the Internet.

The importance of this study cannot be underestimated. The United States is facing a swing in the population demographics towards the upper echelons of the age spectrum. Communications technologies must be made accessible for users who are coping with various kinds of limitations. Otherwise, we run the risk of leaving behind a

large part of the Baby Boomer generation as they enter into their senior years. While

much work has been done in many areas of geriatrics with regard to Internet usage, this

research project has attempted to fill a void in the area of cognitive decline and,

specifically, Mild Cognitive Impairment.

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APPENDICES

Appendix A – Recruitment Flier

Do you have trouble using the Internet?

Do you think your troubles with the Internet are caused by memory problems?

If you answered YES to both questions,

and would like to participate in a research study,

please contact:

Joshua Berkov
berkov@email.unc.edu
(919) 929-1406

You must be 65 years of age or older to participate

This study will take no more than 90 minutes to complete.

This study is approved by the Behavioral IRB at the
University of North Carolina at Chapel Hill(IRB study #07-0012).

Joshua Berkov
(919) 929-1406
(614)561-2928 cell
berkov@email.unc.edu

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Appendix B – Screening Script

Initial Phone Conversation – Recruitment of participants

(participant initiates phone call after seeing recruitment flier)

Principle Investigator: Hello

Potential Participant: (some form of explanation for call, this will vary)

PI: Thank you for calling. Let me give you a brief description of this study. I am interested in studying how cognitive impairments may affect a person's ability to use the Internet. I am attempting to find out if there are any tasks associated with Internet usage that are harder for people with cognitive impairments to do. To accomplish this, I will be interviewing people with cognitive impairments and will also be observing such persons while they use the Internet. Are you still interested?

PI: (if PP says no) Thank you for your consideration. Have a good day.

PP: (If yes, then continue.)

PI: I will need to ask you a few questions to make sure you are qualified to participate in this study. Are you over the age of 65?

PP: Yes

(if PP answers no, say "Participants need to be over the age of 65. My apologies, but you will not be able to participate in this study. Thank you for your consideration. Have a good day.")

PI: Do you believe you have a mild cognitive impairment? In other words, do you believe you have mild problems with memory or with thinking?

PP: Yes

(if PP answers no, say "Participants need to have a cognitive impairment. My apologies, but you will not be able to participate in this study. Thank you for your consideration. Have a good day.")

PI: Have you used the Internet within the past six months? This can include visiting websites, sending and receiving emails, and chatting with people online.

PP: Yes

(if PP answers no, say "Participants need to have recent experience with the Internet because the Internet continues to change. My apologies, but you will not be able to participate in this study. Thank you for your consideration. Have a good day.")

PI: Regardless of your current living situation, could you live independently if necessary?

PP: Yes

(if PP answers no, say "Participants need to have the capability to live on their own if necessary. This is necessary in order to obtain full and informed consent My apologies, but you will not be able to participate in this study. Thank you for your consideration. Have a good day.")

PI: You are eligible to participant in this study. Let me now gather some information about you. What is your name?

PP: (PP states name)

PI: What is your phone number? I will phone you the day before we have the interview, to remind you of the time.

PP: (PP states phone number)

PI: When and where would you like to do the interview? Please choose a place the allows for some privacy.

PP: (PP states location, time, and address)

PI: Would you be willing to allow me to observe you while you use the Internet? This is optional.

PP: (either yes or no)

PI: Do you have a spouse, partner, or companion that would also be interested in participating in an Interview?

PP: (either yes or no. If yes, an interview will be scheduled with that person, either at the same time or at a different time that is convenient for the companion.)

PI: I will see you at (the location) on (the day) at (the time). Thank you!

Appendix C – Consent Form

University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Participants
Social Behavioral Form

_____

IRB Study # 07-0012
Consent Form Version Date: 01/29/2006

Title of Study: Elderly Internet Users Who Have Mild Cognitive Impairment

Principal Investigator: Joshua Berkov
UNC-Chapel Hill Department: School of Information and Library Science
UNC-Chapel Hill Phone number: 919-962-8072
Faculty Advisor: Barbara Wildemuth

Study Contact telephone number: 919-929-1406
Study Contact email: berkov@email.unc.edu
_____

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary.
You may refuse to join, or you may withdraw your consent to be in the study, for any
reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help
people in the future.   You may not receive any direct benefit from being in the research
study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this
information so that you can make an informed choice about being in this research study.

You will be given a copy of this consent form. You should ask the researchers named
above any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to learn how changes in memory or thinking affect
one's ability to use the Internet. As the population in the United States begins to age, the
percentage of people with cognitive impairments will increase. Will they begin to have

trouble using the Internet?

How many people will take part in this study?

Between 12 and 24 people will participate in this study.

How long will your part in this study last?

The interview will last no longer than 90 minutes. This is the extent of your participation.

What will happen if you take part in the study?

You will be interviewed about your experiences with the Internet. You may choose not to answer any question for any reason.

You will then be asked to step through and complete two Internet-related tasks. The first task will be of your choosing, and the second task will be given to you. Completing these tasks is optional.

The interviews will be recorded and transcripts will be made. You will not be identified by name in any way.

What are the possible benefits from being in this study?

This research will produce a set of recommendations. These recommendations will help web designers to make websites or accessible for people with mild cognitive impairments. You may not benefit personally from being in this research study.

What are the possible risks or discomforts involved from being in this study?

Your initial impressions of your abilities to use the Internet may be inaccurate. For better or for worse, you may be surprised at what you are able or not able to accomplish. Participating in this study may also shed light (for better or for worse) on the severity of your condition or of the condition of your spouse, partner, or companion.

There may be uncommon or previously unknown risks. You should report any problems to the researcher.

How will your privacy be protected?

Participants *will not* be identified in any report or publication about this study. No record of names or places will be kept. There is no risk of your interview being identified. You will be referred to as a participant or a companion. Transcripts will be kept on a

password-protected laptop. Recordings of the interview will be kept in a locked home. Recordings and Transcripts will be destroyed when the study is finished.

Will you receive anything for being in this study?

As a study participant, you will be offered the opportunity to have a $10 donation made to the charity of your choice. This donation can be made anonymously if desired.

Will it cost you anything to be in this study?

The only costs for participation include time and travel expenses (gas, parking). If the interview takes place at your place of residence, there are no costs to you.

What if you have questions about this study?

You have the right to ask any question. Any question you ask will receive an answer. If you have questions, or concerns, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

- -

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

_____   _____
Signature of Research Participant   Date

_____
Printed Name of Research Participant

_____   _____
Signature of Person Obtaining Consent   Date

_____
Printed Name of Person Obtaining Consent

Appendix D – Interview Schedule

Questions for Participant

1. Are you currently using the Internet? If no, why not?
2. How long have you been using the Internet?
3. Were you using the Internet before you realized you had a cognitive impairment ?
4. What do you use the Internet for?
5. What aspects of the Internet do you use? Email, Chat, IM, Web?
6. Could you please describe some of the difficulties you face when using Email?
7. Could you please describe some of the difficulties you face when using Chat?
8. Could you please describe some of the difficulties you face when using the Web?
9. Are there other problems you have with the Internet?
10. Please describe any other frustrations that we have not discussed.
11. What improvements would you make to the Internet?
12. Is there anything on the Internet that you just can't do?

Questions for spouse, partner, or caretaker

1. Is your companion using the Internet? If no, why not?
2. How long has your companion been using the Internet?
3. Was your companion using the Internet before s/he developed a cognitive impairment?
4. What does your companion use the Internet for?
5. What aspects of the Internet does your companion use? Email, Chat, IM, Web?
6. Could you please describe some of the difficulties your companion faces when using Email?
7. Could you please describe some of the difficulties your companion faces when using Chat?
8. Could you please describe some of the difficulties your companion faces when using the Web?
9. Are there other problems your companion has with the Internet?
10. Please describe any other frustrations that we have not discussed.
11. What improvements to the Internet would help your companion?
11. Is there anything on the Internet that your companion just can't do?

Appendix E – Observation Tasks Script

Thank you for agreeing to be observed.

Today, you will be "thinking aloud" as you do some things on the Internet. What I mean is that you should tell me everything that's going through your mind as you complete a particular task. So that you can get used to this way of working, we're going to practice first. First, I'll do a task, and think aloud while I'm doing it, so you can see what I mean. I'm going to take the staples out of this stapler that I brought with me, and I'll think aloud while I do it.
(The researcher takes the staples out of the stapler, thinking aloud during the task.)

Now, I'm going to ask you to practice by "thinking aloud" while you put the staples back into the stapler. Just go ahead and put the staples in, and tell me everything you're thinking as you do it.
(Give the participant the stapler and staples, so that he/she can complete the task and think aloud.)

Now, we'll do some tasks on the Internet, and I'll ask that you think aloud as you work on them.

First, please choose a task that you recently completed that relates to the Internet in some way….Email, Chat, Searching the Web, visiting web pages. Try to choose a task that provided some difficulty for you. This task may include a difficult search, an unexpected error message, or anything else that caused problems.

(brief pause)

Take as much time as you need to think of an appropriate task.

(Answer any questions participants may have)

While you are completing the task, please verbalize all of your thoughts about the task.

Please describe your task, and then begin.

(remind participants to think aloud if participants stop talking)

(upon completion of the task, continue below)

Now we will continue with another task. For this task, you will figure out how to contact United States Senator Richard Burr over the Internet.

 Please open Internet Explorer by doubling clicking on the blue E on the desktop.

Please type in www.senate.gov into the address bar and then hit Enter. (point to the address bar if necessary).

You are now at the home page for the United States Senate. Please find a link that will take you to Senator Burr's website. Once you are there, please find a link that will take you to a website that will allow you to submit a letter over the Internet.

(this may require some help. Help participants when necessary. The goal is to be able to repeat this search later on)

(upon completion, continue)

Please repeat the task. See if you can find that contact form for Senator Burr again.