

**ICT for Social Communication
by Seniors Aging in Place**

**Seniors and ICT Project
Draft Report
June 2004**

Confidential – do not distribute without permission

**National Research Council
Institute for Information Technology – e-Business**

**Copyright © NRC 2004
Report No. ERB-1110 - NRC 47146**

This report is an internal research document of the Seniors and ICT project, National Research Council Institute for Information Technology. Please do not distribute without permission of the authors. The views expressed are those of the authors, who welcome feedback.

Copyright © NRC 2004
Report No. ERB-1110 - NRC 47146

ACKNOWLEDGEMENTS

The authors would like to thank the participants of the consultation sessions, who generously gave their thoughts and opinions to the project in development, and also our colleagues at the NRC-IIT e-Business in Fredericton who contributed valuable feedback along the way. Data informing the senior citizen profile in the Annex to this report were acquired through the Data Liberation Initiative at the University of New Brunswick and are subject to licensing agreements therein.

NRC-IIT RESEARCH TEAM

Dr. Susan O'Donnell
Dr. Murray Crease
Sandy Kitchen
Dr. Irina Kondratova
Dr. Andrew Reddick

RESEARCH PARTNER

Mary-Frances Laughton, Industry Canada, Assistive Devices Industry Office (ADIO)

CONTACT INFORMATION

Address:

National Research Council
Institute for Information Technology – e-Business
46 Dineen Drive
Fredericton, NB
Canada E3B 9W4

Research leads:

Dr. Andrew Reddick | Dr. Irina Kondratova
Andrew.Reddick@nrc-cnrc.gc.ca | 506-444-0390
Irina.Kondratova@nrc-cnrc.gc.ca | 506-444-0489

Business contact:

Marc-Alain Mallet
Marc-Alain.Mallet@nrc-cnrc.gc.ca | 506-444-0394

Contents

Executive summary	1
Opportunities for collaborative research	8
1: Introduction	10
2: Relevant technologies and computer science approaches.....	16
3: Social science concerns with the needs and capabilities of citizens	23
4: Overview of aging in place	27
5: Social communication issues for seniors	31
6: ICT for social communication by seniors	36
7: Other ICT for seniors	44
Annex: Statistical Profile of Senior Citizens and Baby Boomers in Canada.....	49
References	78
Appendix 1: Project consultations to date.....	90
Appendix 2: Glossary.....	91

Executive summary

Seniors and ICT is a research project of the National Research Council Institute for Information Technology, located in Fredericton, NB. The research partner is the Assistive Devices Industry Office (ADIO), Industry Canada, Ottawa.

The project team has social science, computer science and engineering expertise. The team will conduct the research over three years, from January 2004 to December 2006, with four phases of work. This report marks the end of the first phase.

Consulting with users and stakeholders is central to the Seniors and ICT research process. The two consultations to date on project have identified strengths and weaknesses that have been addressed as part of the project development. Future consultations are in the planning stage.

Chapter 1: Introduction

This report describes the research to date on the Seniors and ICT project. The project is conducting research for the development of intuitive, reliable and easy-to-use information and communication technology applications (ICT) to assist senior citizens who want to continue living at home. There are many ICT applications that would be useful for seniors. The focus of this project is ICT for social communications.

The analysis and technologies developed by the project will benefit not only seniors but also a wide range of other citizens, particularly informal caregivers and members of seniors' extended families. Many seniors are also people with disabilities. Most seniors are women. Many seniors are living in First Nations or cultural minority communities. The project will consider these and other aspects of seniors' lives and ensure that the research is inclusive and that technology development is aimed at a wide spectrum of Canadians.

Supporting independent living for seniors is a focal point for government policy. All three levels of government are involved with seniors. At federal level, the Canadian Seniors Partnership (CSP) and the CSP Advisory Panel, as well as the Seniors Canada On-line web portal are growing focal points of activities.

The background to the project is the growing number of senior citizens in Canada, the desire for senior citizens to age at home, and the potential opportunities offered by ICT. However the ability of seniors to engage with ICT is affected by the digital divide.

The *Annex* to this report profiles senior citizens and Baby Boomers in Canada, focusing on the broader social and economic context of their lives. This broad analysis highlights the important issue of the digital divide and highlights the social and economic restraints and barriers associated with using technology effectively.

Chapter 2: Relevant technologies and computer science approaches

ICT and social communication is the focus for this project because this is the area in which the research team can make the biggest impact. The team's background research found that most senior-related technology research does not focus on social communication, even though this area could potentially benefit the most users.

Information and communication technology (ICT) is becoming more available and useful. The availability of high-speed networks is also increasing. The report discusses technologies relevant to the Seniors and ICT project including the Internet, wireless connectivity, and interactive television.

Computers are becoming more and more part of the fabric of our society. Computers embedded in every day devices are capable of both processing information and communicating with each other. It is easy to imagine embedding an application designed to aid seniors in an object they may well use everyday.

Assistive devices and technologies can offer great benefits to many seniors. However research has found that in some cases seniors would not use these technologies because of their appearance and the perception they would be stigmatized if they used them. For this reason, the project team believes that ICT for seniors can only be considered usable if users find them useful and are not embarrassed to use them.

The computer science approach of Human Computer Interaction (HCI) is a strength of the research team and a focus for the technology development process. HCI is concerned with improving the experiences of technology users. The Seniors and ICT project can build on much existing work in the HCI field.

Chapter 3: Social science concerns about the needs and capabilities of citizens

Awareness is growing that ICT development should centre on user needs. However the question of how to develop ICT to meet human needs remains largely unanswered by researchers. The topic combines computer science and engineering with social science because human needs can only be understood within their broader social, cultural, economic and political contexts.

One way to move forward is to conceive of technology "users" as "citizens." This approach was suggested recently by computer scientists working in the new area of pervasive computing. The term "citizens" describes users in their broader social, economic, political and community contexts. Further, citizens are conceived as having rights and responsibilities that can be extended to the new information and communication spaces created by ICT.

Research on the digital divide has highlighted that the uneven distribution of social resources is linked to different capabilities to effectively use ICT. The work of economist Amartya Sen has been influential in developing a "capabilities" approach to

understanding ICT diffusion and development. Capabilities can be defined as the range of options for action that a person has available. Technology development should focus on what people can or cannot do with technologies and the benefits they do or do not derive from them.

The Seniors and ICT project is using a model of ICT development that integrates the concepts of citizen needs and citizen capabilities into the technology assessment and design processes. Research integrating citizen needs, citizen capabilities, how citizens make sense of information, and how they engage with ICT is a core focus of Seniors and ICT.

Chapter 4: Overview of aging in place

Research has identified six core needs for seniors related to aging in place:

- Financial security
- Health and health care
- Social communication
- Housing and supportive services
- Safety
- Transportation

Financial security is critical to seniors' activities and the services they rely upon – what seniors can do is determined by how much money they have. Social communication includes networks with informal caregivers as well as participation in community, education, cultural and other productive activities. Social communication provides emotional and practical support as well as keeping seniors connected with their communities.

Staying in their own homes and having access to support and services to adapt their homes is another central need. Seniors must feel secure and safe at home and in order to leave their homes and engage in social activities. As well, they need access to affordable transportation in order to engage in social activities and access many social services.

Gerontology researchers working in the fields of environmental gerontology and social gerontology have studied why seniors move from their homes, why they stay, and what their needs are to live independent and fulfilling lives. The Seniors and ICT project is using both these perspectives to focus not only on the needs of individual seniors related to aging in place but also on the broader social structures related to the decisions that seniors make about meeting their needs.

In Canada, considerable research has concluded that seniors need support in order to stay in their homes as long as possible. Support interventions can reinforce functioning and social structures as well as develop new skills, enable successful coping strategies and alleviate social isolation. Informal caregiving has been highlighted in numerous studies as

an important aspect of seniors' lives, especially now that health care provision is shifting from formal and institutional care to informal and community care.

Chapter 5: Social communication issues for seniors

The review of research found that seniors have three broad areas of needs related to social communication, all of which have a range of associated needs:

- Communication
- Interpersonal interactions and relationships
- Participation in community, social and civic life

Research has highlighted five ways that communication changes as people age. These changes, which vary greatly among seniors, are:

- Perception
- Cognitive interference
- Speed and time
- Motivation
- Opportunity

Perception refers to changes in sensory functions. It is well-known that vision, hearing, smell and touch functions decline over time, especially after the age of 50. Hearing loss is especially prevalent. This decline in functionality can make seniors feel uncertain and concerned about missing the details of communication.

Cognitive interference relates to the ability to process irrelevant or excess information and affects the quality and style of communication. As people age, they lose the ability to ignore irrelevant information and screen out background noise and information. Seniors need more time to retrieve and respond to information. In verbal exchanges, seniors may have trouble understanding people who speak quickly.

The fourth change is motivation. Seniors need to be motivated positively and actively when they attempt to communicate and engage socially. The fifth is opportunity: seniors, especially after retirement, spend more time at home and less time engaging in communication with others outside their home. Using ICT may be one way that seniors can regain opportunities for social communication with people outside their homes.

Seniors' communication needs lead to sharing information on three different levels. General information is freely exchanged by seniors with their casual acquaintances and neighbours with no risk involved. Information that may compromise their social standing cannot be freely shared with neighbours and casual acquaintances and is reserved for family members.

Finally, secret information is shared confidentially with the few persons considered by the senior to be advisors or caretakers, typically a lawyer, doctor or minister or priest,

who are ethically bound to keep this information secret. Information on this level includes a problem that the senior cannot resolve alone, such as a self-realization by a senior that they are no longer capable of maintaining their independence.

There are many cultural differences related to aging and social communication. For example, in some cultures, the age of a group member is very important in determining social communication processes; in others it is less important. In some cultures, aging is something to be feared; in others it is seen more positively. Relationships and social communication between young and old are culturally shaped and determined, as they are between women and men.

These cultural differences become very important when developing ICT for social communication, because seniors from different cultures will adopt, use and adapt technologies in different ways. Canada is a multi-cultural society, and experiences of using ICT for social communication will vary among Canadian seniors with different cultural backgrounds.

Chapter 6: ICT for social communication for seniors

The review of research found that seniors are engaged with a wide range of ICT. Television is by far the most popular ICT for seniors. There may be opportunities for interactive television applications to improve social communication, given that seniors are very comfortable and familiar with using televisions. A range of devices are currently on the market to help seniors control their television equipment.

After television, the radio is the ICT that seniors use most; however radio use may decrease with age, as seniors spend less time travelling in cars while listening to the radio. Listening to radio over the Internet is an activity that is becoming more popular with increased penetration and lower cost of broadband but there is no data on seniors' use of radio via the Internet.

Telephones have been the ICT with the greatest positive impact on social communication. Services such as call display, telephone answering systems and voice mail have been very useful for seniors, many of whom lead busy lives. However the cost of some of these services may be prohibitive for seniors on a low income, and some are difficult to use and require training.

Applications that allow seniors to use the telephone for social support may have good potential, with research on senior women with disabilities using these systems experiencing decreased support needs, diminished loneliness, and enhanced coping. Research on automated telephone-based interactive voice response system (IVR) for seniors and their caregivers has been less positive.

Although wireless telephony and broadband is currently the focus of intensive research and development effort internationally, little research has been conducted on wireless applications for seniors. Wireless telephony is not as popular in Canada as it is in many

European countries, where mobile phones are used more frequently than fixed-line telephones.

Many seniors use assistive devices to improve communication. Some assistive devices could be classified as ICT for improved communication – hearing aids are common ones. Assistive devices to improve reading include talking books on audiotape and closed-circuit television enabling the user to magnify a document and view it on a television screen. Computer-based assistive devices for reading include computer screen magnification programs, screen reading software, and scanners and optical character recognition and reading software.

Despite the continued persistence of the digital divide, levels of Internet use by seniors are increasing. Until recently, the low level of Internet use by seniors led to speculation that they were “technophobic” - afraid of computers or new technology. Currently the seniors population online is growing rapidly but many are staying off-line due to lack of perceived need or interest. A range of products and design strategies exist to help seniors use the Internet

There is an ongoing debate by researchers as to whether Internet use increases or decreases social communication. The Internet can both increase and decrease social communication for seniors. Seniors use mass media – including Internet-based media such as email and Web pages - for many reasons, including both as a substitute for social interactions and a means of improving social interactions.

The review of research illustrates that seniors are engaged with many types of ICT. The Seniors and ICT research team sees value in exploring a number of these areas for technology assessment and applications development.

Chapter 7: Other ICT for seniors

Aside from ICT for social communications, many of the other core needs of seniors related to aging in place are being addressed by ICT applications.

ICT has been applied to meet health and health care needs of seniors in different ways. Rapid progress in sensor and communication technology has led to much interest in the concept of home health monitoring. Sensor technology incorporated into the home, coupled with servers to process the raw data, is used to monitor the well being of the occupants.

The successful uptake of such systems is largely dependent upon two factors: cost and aesthetics. It is hoped that although the systems may themselves be expensive they will still be a cheaper alternative than living in an institution. The aesthetics of the system must be appropriate so that the users do not feel that they are being labelled as inadequate by the use of obviously assistive or seemingly institutional technology.

Researchers have used wearable computer technology to provide truly mobile ICT applications for healthcare. The software chip-maker Intel has been investigating how ubiquitous computing technologies can be used to provide an infrastructure for *maintaining wellness* as opposed to curing illness. Intel's research is focussing on four main areas: promoting healthy behaviours; detecting disease early; ensuring patients follow treatment plans and supporting informal care giving.

Smart Home technology is ICT that has been designed to enable a home to react to its occupants' needs. Smart Home technology can range from individual sensors for a particular need to a house which is able to detect all the activities of the occupants. As technology in the home becomes more widespread a side-effect is that the use of this technology becomes more complicated.

This is evidenced by the range of devices such as televisions, microwave ovens and telephones which have an ever increasing function set but at the cost of decreasing usability. One solution is to develop a natural language interface to household appliances. This would have several advantages: the user would be able to operate devices remotely; the devices could be operated hands-free; and multiple remote controls would not be necessary to operate multiple devices.

Other ICT applications that meet the needs of seniors include those that can help them stay safe in their homes, memory aids, and those providing information to help with financial and transportation needs. The latter includes computers in cars that manage tasks as varied as engine management and diagnostics; cabin temperature control and detecting obstacles when parking.

ICT for seniors range from relatively simple, single purpose applications to complex applications that are designed to meet many different needs of the users. The majority of commercially available applications fall into the former category with many research projects falling into the latter category. The overriding concerns for an end user are cost and aesthetics. If the benefit of a system can be seen to be worth the financial outlay and the system does not appear to stigmatise the user, then it is more likely to be commercially successful.

Annex: Statistical profile of senior citizens and Baby Boomers in Canada

An Annex to this report includes an analysis of statistical data – primarily data sets from Statistics Canada – to provide a comprehensive profile of seniors and Baby Boomers in Canada. The Annex includes three tables and more than 25 new figures that chart a range of demographic data. Included in this profile is an analysis of data from 2000 that looks at seniors and Baby Boomers and their use of ICT. This data is supplemented with the latest survey results on Internet use by seniors from EKOS (2003 and 2004).

The tables and figures include the following:

- Projected number of seniors and Baby Boomers in Canada

- Percentage of senior population in the provinces and territories
- Gender differences in the senior and Baby Boomer populations
- Education levels in the senior and Baby Boomer populations
- Dwelling type and living arrangements
- Income levels based on different categorizations of income
- Disabilities in the senior population
- Prevalence of care for long-term health problems

Tables and figures related to ICT use by seniors and Baby Boomers include the following:

- Importance of ICT in 2003
- Annual expenditure for communicative devices in 2000
- Types of communicative devices owned in 2000
- Amount of television viewing in 2000
- Levels of technology use in 2000
- Ability ranking of Internet users in 2003
- Types of computer use in 2000
- Frequency of email use in 2000
- Types of Internet use in 2000
- Types of medical/health information sought in 2000

Opportunities for collaborative research

Partnership opportunities

The National Research Council has found that one of the best ways to transfer and generate knowledge is through collaborative research. NRC works with research collaborators to adapt and create new products and improve existing products and services.

The Seniors and ICT research team is planning collaborative research opportunities with partners from other sectors – government and public, business and commercial, and community and non-profit – who share an interest in learning more about the needs and capabilities of seniors related to aging in place and applying this knowledge to ICT applications development.

Research partners will be already be working or engaged with seniors in some capacity, such as developing or delivering products, programs or services for seniors. For government and public sector partners, collaborative partnerships can include developing new knowledge about seniors and their needs leading to improved policy and service delivery.

Types of projects foreseen

Seniors and ICT is an umbrella project. The research team will be exploring partnership research projects related to Seniors and ICT and the issues discussed in this report. Initial Phase 2 research opportunities which will be assessed include:

- Broad needs assessment – a national survey and qualitative research (interviews and focus groups) of seniors and Baby Boomers to develop new analysis of their information, communication and other needs and capabilities related to aging in place
- Targeted consultations or pilot projects involving seniors and Baby Boomers in specific communities with specific ICT applications that could be improved or developed
- Adding a social communication dimension to e-health applications, particularly tele-homecare applications using a range of existing and new technologies
- Applications to meet the social needs of First Nation communities
- e-Government applications for senior citizens, with a focus on addressing needs and capabilities for engaging with different channels of service delivery, and adding a social communications context to online service delivery applications

Project timelines

The Seniors and ICT project began in January 2004 and is expected to run until December 2006. There are four phases of work:

- Phase 1 - Research aimed at understanding ICT for seniors aging in place – this phase was completed with the release of this report.
- Phase 2 - Needs analysis and project planning
- Phase 3 - ICT applications development
- Phase 4 - Dissemination

1: Introduction

This report describes the research to date on the Seniors and ICT project. The objective of the first phase was understanding ICT for social communication for seniors aging in place. The work included:

- Conducting a comprehensive review of published literature that highlights:
 - the social challenge of aging in place
 - the needs of seniors related to aging in place, in particular their social communication needs
 - relevant technologies and research approaches
 - the experiences of seniors with ICT for social communication
- Scanning the market for existing technologies for seniors
- Developing a statistical profile of seniors and Baby Boomers
- Engaging in consultations with experts working with seniors' groups

Based on the results of this initial work, this report covers the following topics:

- Introduction and background to the project
- Relevant technologies and computer science approaches
- Social science concerns with the needs and capabilities of citizens
- Overview of aging in place
- Social communication issues for seniors
- ICT for social communication by seniors
- Other ICT for seniors
- Statistical profile of seniors and Baby Boomers in Canada

Seniors and ICT will develop ICT for aging in place

The project aim is to conduct research for the development of intuitive, reliable and easy-to-use information and communication technology applications (ICT) for social communication to assist senior citizens who want to continue living at home.

Social communication is communicating with friends, family, informal caregivers, and people in the community or wider world sharing common interests.

The central research concern is “aging in place,” a term referring to senior citizens aging in their own home – an environment that is not institutionalized, such as their own home or living with relatives. Aging in place has become an increasing policy priority by governments in Canada and internationally.

The project results have potential benefits for all citizens

The analysis and technologies developed by the project will benefit not only seniors but also a wide range of other citizens. The inclusive research approach is mindful that being a senior is only one aspect of being a citizen aged 65 plus. Many seniors are also people

with disabilities. Most seniors are women. Many seniors are living in First Nations or cultural minority communities. The project will consider these and other aspects of seniors lives and in the process ensure that the research is inclusive.

In addition, the research to date on the project has highlighted the importance of caregivers in the lives of seniors. The communications that seniors have with their caregivers are critical to their continued well-being, and so caregivers are also a central focus of the analysis and technologies developed by the Seniors and ICT project.

The background to the project is ... the growing number of senior citizens in Canada

Seniors make up an increasingly larger share of the Canadian population. By the year 2011, there will be more seniors 65 years of age and over than children 14 years of age or younger.

This situation can be largely explained by the Baby Boom cohort. Baby Boomers are Canadians born during the decade following the end of World War II. During that decade, increased prosperity and improved technology contributed to renewed confidence in the future and an increased desire to have children.

Although many OECD countries experienced a Baby Boom after WWII, it was most dramatic in the US, Canada and Australia. As the Baby Boom cohort passed through the decades, the increased number of citizens meant changes in economic and social systems. For example, the 1950s and early 1960s saw an increase in children attending elementary school and a corresponding need to provide more schools and teachers. Now the Baby Boom cohort is approaching retirement age.

... the desire for senior citizens to age at home

A consistent research finding is that aging at home is desired both by senior citizens and their family caregivers. The home environment is seen as providing a higher quality of life than an institutional environment. Living at home promotes a sense of normalcy and familiarity as seniors age. Senior citizens also feel more autonomous and in control in their own home environment, which is important for their overall well-being.

At the same time, there is a growing desire by all levels of government for senior citizens to age at home. As demands increase on public sector resources, the resources necessary to place and maintain seniors in health care institutions become more difficult to find. Whether community-based health care is indeed less expensive than institutional health-care is a point of some debate (Keating and Cook, 2001). However supporting seniors and their informal caregivers in non-institutional settings has become a policy priority.

... and the potential opportunities offered by ICT

Seniors have many needs related to aging at home, not all of which are met by current ways of doing things and existing technologies. Social communication is a core need of

seniors at home. Social communication activities include using ICT such as mobile telephones to maintain relationships with friends and family, and watching television and listening to the radio to keep up with events in the wider world.

Increasingly, senior citizens are logging on to the Internet to meet some of their social communication needs. Web and e-mail based technologies offer tremendous potential for social communication. Other ICT such as videoconferencing, interactive television and new mobile telephony devices are less well-known by seniors but also offer great potential to meet their social communication needs.

A core focus of the research is understanding the specific needs of senior citizens and identifying which everyday needs could be met with intuitive, reliable and easy-to-use new ICT applications.

The digital divide affects the ability of seniors to engage with ICT

The annex to this report profiles senior citizens and Baby Boomers in Canada, focusing on the broader social and economic context. This broad analysis highlights the important issue of the digital divide. Highlighting the digital divide puts the focus on the social and economic restraints and barriers associated with using technology effectively.

The term “digital divide” describes the gap in ICT use – primarily use of computers and the Internet – between individual citizens, households and geographic areas by different socio-economic factors, and between countries and regions at different stages of economic development. In Canada, Reddick et al (2000) have identified a “dual digital divide” in which different groups of Canadians have different levels of use and some groups see little value in using the Internet. As discussed in the annex to this report, the most recent research in Canada on the digital divide identifies seniors as a group with low levels of Internet use (EKOS, 2004).

An OECD survey of ICT and the information economy concludes that: “The digital divide may be said to be both growing and shrinking. When examined in terms of access gap (difference in absolute percentage points), the gap appears to be widening. When examined in terms of growth rate, the digital divide appears to be closing” (OECD, 2002).

Researchers have made a strong link between access and use of ICT and social inclusion and citizenship. For example, British researchers have theorized about the impacts of “information poverty” and political inequality on citizenship and have argued that Internet access has become a basic cultural right of citizenship in the 21st century (Murdock, 1986; Murdock and Golding, 1989, Murdock, 2002). As more and more government and public information is made available online, access to the Internet and other ICT is becoming increasingly important for citizens.

Supporting independent living for seniors is a focal point for policy

The report from the Prime Minister's task force on active living and dignity for seniors (2004) identified independent living for seniors as a strategic focus. It advocated improving the interactions between seniors and governments and improving supports for seniors in communities. The report identified two areas for this work: improving how governments deliver services to seniors, and testing how supports for independent living could enable more seniors to remain living longer in their homes.

Improved delivery of government services to seniors includes improving services by telephone and meeting the needs of the growing number of seniors who prefer to access services through the Internet. The report noted that the need for online services for seniors is set to grow rapidly because Baby Boomers, tomorrow's seniors, have a higher level of Internet use.

All three levels of government are involved with seniors

A wide range of services for seniors are delivered by all three levels of government. The provincial and territorial governments have a primary responsibility for seniors through their health services, such as provincial health insurance, community-based health programs and drug benefit programs. Related to these are long-term care programs and home care and support services for seniors and others who need assistance for independent living.

Provincial and territorial government also have income support systems for low-income seniors, and property and sales tax credits that benefit seniors. The different types of programs and levels of support vary across the provinces and territories.

Municipal governments across Canada offer a diverse range of services and programs to seniors, from dental services to long-term care facilities and community-based support programs for seniors. Municipal governments also play an important role in assisting housing options for seniors, through property tax and social housing programs for seniors. Also operating at municipal level are numerous community and voluntary programs for seniors, such as "meals on wheels" and other support programs.

The federal government provides a wide range of programs and services for seniors (Government of Canada, 2002). Social Development Canada administers the public pension programs, providing a range of pensions, supplements and benefits to more than 4.6 million seniors and their families. Veterans Affairs Canada provides a range of benefits, including the War Veterans Allowance to Canadians with wartime service and their families. The Canada Revenue Agency delivers benefits for seniors through tax credits for age and pension income.

Canada Mortgage and Housing Corporation (CMHC) conducts research, supports innovation and provides information about housing for seniors and their housing needs.

They also publish and widely distribute a guide for maintaining seniors' independence through home adaptations (CMHC, 2003).

Health Canada carries out health promotion programs for seniors and conducts research into the health of seniors and the health care system as well as seniors in First Nations and Inuit communities. Health Canada's division of Aging and Seniors and its National Advisory Council on Aging are core resources on seniors issues.

Other federal departments are also involved in seniors' programs. The Canadian Seniors Partnership (CSP) and the CSP Advisory Panel and the Seniors Canada On-line web portal are growing focal points of expertise and activities.

Many of these government activities offer an opportunity for seniors to engage with their information, programs and services using ICT. In addition, there may well be opportunities to add a social communication dimension to this engagement if seniors could use ICT within the context of these government programs and services to communicate with friends, family, informal caregivers, and people in the community or wider world sharing common interests.

The project team has social science, computer science and engineering expertise

Seniors and ICT is a collaborative project of two research groups in the NRC's Institute for Information Technology – the e-Government/e-Citizen and the Human Web groups. Together, these two teams offer significant expertise in social science, computer science and engineering.

The expertise includes technology research centred on the needs of “citizens” – technology users with diverse social, cultural and political needs and capabilities – as well as people in their environments, human-computer interaction, and user needs analysis.

Technical expertise includes research in mobile computing, multimodal interaction, augmented reality, privacy and security, natural language processing, voice technologies, and community informatics.

The project will be conducted over three years

The project began in January 2004 and is expected to run until December 2006. There are four phases of work:

- Phase 1: Research aimed at understanding ICT for seniors aging in place
- Phase 2: Needs analysis and project planning
- Phase 3. ICT applications development
- Phase 4. Dissemination

Consulting with users and stakeholders is a central focus

The research team's analysis of previous research has highlighted how important it is to consult with the users of the proposed technology and the organizations and groups who work with and represent them. Many technology development projects fail simply because they did not consult with users and stakeholders in the early stages of the research. Consultations with these experts are invaluable because they can point out problems with the research design that the researchers have missed but are obvious to experts who are users themselves or work with users and understand their needs.

The two consultations to date on the Seniors and ICT project have been successful in identifying strengths and weaknesses of the project in development. Future consultations are in the planning stage and will be a central focus of the project until its completion.

2: Relevant technologies and computer science approaches

This chapter discusses why ICT for social communication is an important research area and reviews some key computer science research areas and technologies of primary significance to this project. Clearly many other research areas – such as hardware design – may also be of great importance but this section describes the areas of immediate relevance.

Designing for social communication allows the research team to make the biggest impact

The Seniors and ICT project is investigating how ICT can be used to meet the social communication needs of seniors. Social communication is the focus for this project because the research team can make the biggest impact in this area. Most senior-related ICT research does not focus on ICT for social communication, even though this area could potentially benefit the most users.

Most research intended to benefit seniors is focussed on health issues either directly - in the form of technology designed to help users live with disability or illness – or indirectly in the form of health monitoring. However seniors, whether or not they are disabled, are interested in many things other than their health. Social communication is an application area that will benefit all seniors - whether it with peers, informal care-givers or distant family, the ability to communicate will benefit all.

Although the research team is interested in building systems for seniors, by their very nature social communication systems will benefit other types of users. Informal care-givers and remote family members are the obvious potential beneficiaries of such systems. Indeed, it is conceivable that such systems could prove to be beneficial to many different types of users, not just those interested in communicating with seniors.

The availability and utility of technology is increasing

Moore's Law (Moore, 1965) states that the number of transistors (and hence processing power) able to be placed in a single computer chip would double every 18 months or so. In the nearly 40 years since its publication, this law has mostly held true. This has led to a massive increase in the processing power and memory of computers in the intervening period which has led to a greatly reduced cost of computing power. A corollary of Moore's Law is that it is possible to put a fixed amount of processing power into an ever decreasing space. This enables devices that rely on this processing power to become smaller and cheaper.

Examples of such devices include fully functional digital cameras the size of a credit card, web cams which incorporate digital video cameras and a microphone for simple video conferencing (e.g. both available at www.logitech.com) and mobile telephones which incorporate Global Positioning System (GPS), Internet and digital camera capabilities (e.g. <http://www.telusmobility.com/>). Although the cost of such devices is

always falling, it may still be considerable. This may be prohibitive as the benefits of such devices may not be clear. A web cam, for example, requires a computer, an appropriate network connection and – most importantly – someone with similar capabilities to talk to.

The availability of high speed network connections is, however, increasing rapidly. There are many different network technologies, each of which provides different capabilities. The following list provides a short summary of the technologies typically available to a home user:

- Internet access
 - Dial-up Internet access allows a computer to communicate with the Internet via a regular phone line. It is not possible to use the phone while connected. The maximum connection speed is typically 56kb/s. Because the Internet and telephone connections share the same telephone line the Internet connection clearly cannot always be available.
 - High speed Internet access (broadband) is 10 to 60 times faster than dial-up and does not block telephone usage. The connection is always available.

- Wireless connectivity
 - Bluetooth (www.bluetooth.com) is a short range (line of sight) wireless communication protocol which is used to connect a user's devices at 720kbps. Toyota, for example, has produced a car which can automatically connect to a previously registered Bluetooth-enabled cell phone and hence manage hands free calls while driving (<http://www.toyota.com/prius>).
 - WiFi is designed as a replacement (or complement) to an existing Local Area Network (LAN). A single access point can cover an area the size of a small building while many can be used together to form a wider network (e.g. the Fred e-Zone – www.teamfredericton.com – which covers the downtown area of Fredericton, NB).
 - Cell phone data transfer techniques allow cell phone users to access data networks. Known as third generation networks (3G) they allow communication at about 144 kb/s.

Each of these communication techniques has advantages and disadvantages. Bluetooth, for example, has only a limited range but can reasonably accurately specify a user's location whereas WiFi can only give a general idea of the location. Both of these technologies allow users freedom to move whereas a broadband connection does not – unless combined with a mobile technology such as WiFi.

Interactive Television (ITV) extends the standard television paradigm - which only allows the user to passively view content - by allowing the user to actively interact with the content provider. This interaction may range from changing the viewing options such

as camera angles or audio channels to allowing the viewer to communicate directly with the content provider. This communication is typically provided through a set-top box. ITV can also be used to allow the user access to proprietary services which are not otherwise available. ITV can also allow access to the Internet although limitations in the capabilities of the set-top boxes mean this is not always very effective. As of 2002 it was estimated that approximately 3 million households in Canada had access to ITV [CRTC, 2002]. By building on the form of ICT most commonly used by seniors ITV may well play an important role in the future use of ICT by seniors.

Human-Computer Interaction puts the user at the centre of the design process

Human-Computer Interaction (HCI) is the computer science research area that considers how to make interactive computer systems easy to use. The humans (or users) in question can vary from a highly computer-literate user to a user who has never used a computer before. The number of users considered may vary from one for a standalone application to many for a collaborative system. The computer in question may vary from a standard desktop machine to an embedded computer such as those found in an Automated Bank Machine or car. An important new area of HCI which has rapidly expanded in recent years is that of mobile computing which considers the interaction needs of users that are no longer tied to the desktop, e.g. (Chittaro, 2003).

HCI covers a range of different techniques which all share the same goal of improving the user experience. These techniques include: software architectures - to support user needs; task and user modelling - to allow tasks and users to be specified to computer systems; adaptive user interfaces - which adapt to the current user and/or the wider context; multimodal interaction – which employs multiple interaction modalities such as speech, touch and graphics; requirements capture – to determine what is expected of the system; evaluation – to determine whether a system meets its goals and if so how well; and social computing – which considers the needs of the user beyond the system being used.

This is clearly a wide ranging and highly varied group of techniques, albeit a group which share a common goal. The mandate of HCI, however, goes beyond these techniques to consider other, external factors which influence the usability of the system. The quality of network connection being used can, for example, have a direct impact on a system, e.g. (G. Wilson, 2001), and if this is the case the design needs to take this into consideration.

The research team's strength in Human-Computer Interaction (HCI) will allow the research team to design and evaluate the systems so that while they are both appropriate and easy to use for seniors, they should also be appealing to other users.

The needs of seniors have been considered by HCI researchers

A commonly held misconception about seniors is that they are unwilling to use computer technology. Dyck and Smither (1994) found, for example, that older adults had a more positive attitude to computers than younger adults but expressed less confidence. This

may, in part, be due to less experience using computer systems. As the prevalence of computers in the workplace increases, however, more and more recently retired seniors will have this experience.

Another difference between seniors and younger users is that seniors will typically require more training. Although it has not been possible to eliminate this difference it has been shown that appropriate training techniques can minimise the difference in the amount of training required. It has been shown, for example, that procedural instructions – i.e. how to accomplish a goal – are more effective than conceptual instructions – i.e. how the underlying system works - when providing instructions for seniors as it eliminates the need for translating the concepts into actions (Morrell et al, 1995).

The Designing For Dynamic Diversity Project (Gregor, Newell and Zajicek, 2002) acknowledges the differences between older and younger users. It is significant that this research stresses that these differences are just that: differences; not disabilities. This approach is reinforced by Hawthorn who describes seniors as having both strengths (e.g. experience) and weaknesses (e.g. failing sight or hearing) (Hawthorn, 2003). The work in both these cases was examining the design process required to build applications for seniors.

An example of a computer system that was designed with the needs of seniors specifically in mind is a handheld navigation system (Goodman et al, 2004). This system utilises a handheld computer which is able to provide navigational information to the user.

The design process involved seniors from the beginning to ensure that the specific needs of seniors were met. By taking this approach – dubbed User-Sensitive design – the needs of all users were met. This meant that the design for the final application included several different forms of presentation to suit the differing needs of the user group.

Interestingly, one of the main requirements specified by the seniors was that the application should not be seen to identify the user as being somehow inferior. This was also the main problem seniors had with navigating in real life – having to ask for directions made them feel inferior.

An evaluation of the system showed that younger users were able to perform at a similar level with both a paper map and a handheld computer whereas older users' performance with a paper map was significantly worse. Older users were, however, able to perform at the same level as the younger users when using the handheld computer. This suggests that an appropriately designed application can enable seniors to perform at a similar level to the rest of the population.

As ICT becomes more and more a part of everyday life – in much the same way as electricity has – it is both an opportunity and a responsibility to provide systems such as the handheld navigation system which allow seniors to perform at a similar level to younger users.

Ubiquitous computing describes the way computers are becoming woven into the fabric of our society

The terms Ubiquitous Computing, Pervasive Computing and the Disappearing Computer are used to describe the way computers are becoming more and more part of the fabric of our society. Computers are no longer limited to sitting in large boxes under our desks but rather are embedded in every day devices, e.g. (Schenker, 2000). These devices are capable of both processing information and communicating with each other. Because such devices are embedded in everyday objects it is easy to imagine embedding an application designed to aid seniors in an object they may well use everyday anyway.

The MediaCup (Beigl, Gellersen and Schmidt, 2001), for example, is a mug which is capable of communicating with other devices as well as detecting the current state of the contents of the mug. This could be used to automatically brew more coffee (if the cup is empty); alert the drinker to bad contents (if the milk has gone off for example); or generate meeting alerts (if the cup is full and moving towards your office). This last example is one which highlights how relatively simple pieces of technology which generate limited amounts of information can be combined with other information (in this case the sensor the mug is communicating with) to provide valuable information to a user.

The e-Tools architecture (Cortés et al., 2003) is a proposed infrastructure that would enable intelligent assistive devices to be embedded in homes and other facilities commonly used by seniors which would provide support to seniors and their caregivers. Such an idea could be extended to provide the framework for social communication between seniors and their friend, family and care-givers. Ultimately, it is hoped that the existence of such technology will lead to the technology ‘disappearing’ into the background with only the applications the technology enables being visible. This is analogous to the way that electricity is a pervasive yet virtually invisible feature of our lives.

Assistive technology enables users to overcome disabilities

While all technology can be considered to be assistive – i.e. it is designed to assist the user in performing a task – “assistive technology” is defined as technology which is designed to assist users with a view to bringing their performance to a “normal” level. It has been demonstrated that assistive technology such as bath benches and environmental interventions such as ramps and lowering of cabinets can enable seniors to stay at home (Mann et al, 1999). This study also showed that the use of such devices was both cost effective when compared with the costs of institutionalization or in-home care and slowed the functional decline experienced by the frail seniors in the trial.

The ELDer project (Hirsch et al., 2000) undertook a four month study in a seniors community which attempted to determine the design features that would make assistive devices appealing to seniors. Interestingly, one of the major findings of this study was

that functionality is not a primary concern. While important, the aesthetics were found to be the most significant factor.

Examples were cited where seniors knew of the existence of more appropriate assistive devices but would not use them because of their appearance. This is in part because if a device is explicitly presented as assistive the user may well feel stigmatised. The project team argues that despite the improved functionality of the devices, they cannot be considered usable if users are embarrassed to use them. Considering the aesthetics of assistive devices has the further benefit of making the device appealing to the broader community who would also wish to take advantage of its improved usability.

A study on the use of assistive devices as opposed to personal care (Agree and Freedman, 2003) found that assistive devices are the most common means that seniors employ to manage day-to-day tasks. Interestingly though, it was found that although adults who typically employed assistive devices were less disabled than those who employed personal care, it was the former group who were more likely to report that a task was tiring or time consuming. This is indicative of the limitations of assistive devices which can only be overcome with personal assistance.

The Enable Project (Hagen et al., 2002) is a large European-Union funded project which is concerned with the evaluation and development of assistive devices for dementia sufferers. The Enable project is concerned with both the development of products and methodologies. Gibbs et al, (2003) for example, describe a cooker monitor which automatically turns off a stove top if it is left unattended for a period of time. Orpwood et al, (2003) discuss a methodology for designing assistive technology for dementia sufferers. A large part of this methodology is devoted to managing the ethical and practical problems of involving dementia sufferers in the design process.

The design is as important as the functionality

Much of the effort placed into the building of applications is put into functionality. This, however, is not always sufficient. Norman, for example, argues that the emotional appeal of an object is as important factor as its functionality (Norman, 2004). As was previously described in the section of assistive devices the ELDer project (Hirsch et al., 2000) discovered that aesthetics were often placed above functionality in importance. In the case of the ELDer project this was because the users of the devices did not want to feel that the devices somehow labelled them as requiring help. It has also been shown that the aesthetics of a system can affect the usability of a system with users performing better using the more aesthetically pleasing version of two functionally identical systems (Kurosu and Kashimura, 1995).

An example of a system where the aesthetics were important to the users is the Out to Lunch system (Cohen, 1994) which enabled users in a public space (such as a cafeteria) to monitor the high level activity of their colleagues using audio cues. The first version of the system used functional, but not very musically pleasing, tones to inform the users and was universally unpopular. A second version which used sounds developed by a

professional musician was far more popular despite there being no difference in functionality.

Seniors and ICT can build on much existing work

This chapter has described a wide range of computer science techniques (research areas and technologies) that the Seniors and ICT project can build on. The most important consideration is that no one technique should be considered the most important but it is the combination that is significant. It is by combining the different techniques according to their availability, suitability and – most importantly - the users' needs that the Seniors and ICT project will be successful.

3: Social science concerns with the needs and capabilities of citizens

The previous chapter outlined computer science approaches and technologies relevant to seniors and ICT. This chapter discusses some of the social science research concerns with the needs and capabilities of citizens, and outlines an approach to ICT development that considers these concerns.

Awareness is growing that ICT development should centre on user needs

The ways in which people use and shape technology to meet their needs has long been a topic of inquiry by social scientists – “the social shaping of technology” is an academic field in sociology (MacKenzie and Wajcman, 1985). As discussed in the previous chapter, the field of human-computer interaction (HCI) in computer science, as well as human factors engineering in engineering, place technology users at the centre of the technology design process.

Two recent best-selling books have raised popular awareness of the need for technology development to focus on technology users. In *The Human Factor*, engineer Kim Vicente (2003) argues for technology that works for people. In *Leonardo’s Laptop*, computer scientist Ben Shneiderman (2002) calls for a “new computing” movement in the spirit of Leonardo da Vinci, who combined science with art and engineering with aesthetics.

Companies developing commercially successful technologies are also focused on the needs of users. For example, Craig Barrett, CEO of the computer chipmaker giant Intel, recently analysed the company’s past failures and developed a strategy to avoid the old mistakes: work to create products that fit the needs of customers instead of designing products no one has asked for (Edwards, 2004).

ICT users have a “hierarchy of needs”

However the question of how to develop ICT to meet human needs remains largely unanswered by researchers. One challenge is that the topic combines computer science and engineering with social science, knowledge areas that have traditionally been kept separate. Another challenge is that “human needs” is itself a little-researched area.

The most well-known approach to understanding human needs is psychologist Abraham Maslow’s “hierarchy of needs.” Maslow (1968) posited that humans have five categories of needs, beginning with basic physiological needs such as food, water and shelter. Only when these basic needs have been met can humans consider their next category of needs – safety and security needs such as ensuring a safe and secure home environment. When this category of needs has been met, humans can consider the next category – social needs such as affiliation with others. The highest category of needs is self-actualization.

Schneiderman (2002) identified that Maslow’s hierarchy of needs was a guide to the new computing movement because it outlines an orderly spectrum of needs and focuses on action and relationships. However the hierarchy is limited in that it does not identify the

restraints and barriers humans face in attempting to meet their needs. Human needs – and ICT development centred on human needs -- can only be understood within their broader social, cultural, economic and political contexts.

Technology needs assessments do not consider users in their broader context

Traditionally, the process of technology development may include a “technology needs assessment,” a research process that identifies a specific need which can be addressed by existing or new technologies. The technology assessment usually involves a survey of potential technology users to better understand their specific needs.

Theoretically, technology assessment should consider the wider social, cultural, economic and political contexts of technology use. In practice, however, these dimensions are rarely considered. Recent research has highlighted that the social and political elements are integral parts of technology and thus including these elements in the technology needs assessment is essential to developing technologies to meet human needs (Lehoux and Blume, 2000).

The World Health Organization (WHO) has classified human functions and needs

For the past 25 years, the WHO has been developing an international system of classification for human functions and associated needs (WHO, 2001). The ICF is a multipurpose classification that provides a scientific basis and a common language for understanding and studying health and health-related states, outcomes and determinants across different countries and cultures.

The ICF offers researchers a method for classifying human functions and needs – including functions and needs related to ICT. In addition, the classification system places these functions and needs in a broader context of “environmental factors” that encourage or restrict the ability of humans to function – including using ICT effectively.

The ICF is a useful tool because it describes a wide range of human functions and needs for which ICT applications may be developed. It is particularly useful because it situates these functions and needs within the larger context of factors that shape how humans function. However the ICF is limited for ICT development research because it does not describe the broader range of socio-economic factors that shape how people use ICT.

The term “citizens” describes users in their broader contexts

One way to move forward to a more inclusive understanding of technology users is to conceive of them as “citizens.” This approach was suggested recently by computer scientists working in the new area of pervasive computing (Kostakos and O’Neill, 2004). Pervasive computing systems are those designed to be part of everyday life. To reach their full potential, pervasive systems must reach and be of benefit to entire societies, and designing pervasive computer systems requires an understanding of users as citizens. The

term “citizens” describes users in their broader social, economic, political and community context.

Further, citizens are conceived as having rights and responsibilities associated with their membership in social, economic, political and community systems and these rights and responsibilities can be extended to the new information and communication spaces created by ICT (Mosco, 1998).

Citizens have different capabilities to use ICT

Research has analysed public policies and programs in Canada to address the gaps in ICT access and use (Rideout, 2000; Looker and Thiessen, 2003). Access to ICT remains a social and policy concern. There is growing recognition that the uneven distribution of social resources is linked to different capabilities to effectively use ICT.

The work of economist Amartya Sen (1999) has been influential in developing a “capabilities” approach to understanding ICT diffusion and development. Capabilities can be defined as the range of options for action that a person has available. Garnham (1999) has argued that communications researchers should focus on what people can or cannot do with communications technologies and the benefits they do or do not derive from them, rather than focusing on access per se.

Exploring why citizens engage with ICT is a promising way forward for ICT development

The Seniors and ICT project is using a model of ICT development that integrates the concepts of citizen needs and citizen capabilities into the technology assessment and design processes. Building on Garnham’s (1999) focus on capabilities in communication processes, this model is exploring alternative ways to categorize citizens and how they engage in information and communication processes.

Researcher Brenda Dervin (1983 and 1989) has argued that information and communication systems are used by people to make meaning. Collectively, attempts to make meaning can be classified in alternative ways. ICT designers and developers can systematically apply these alternative categories to system design features that will enable greater access and more meaningful use.

Dervin’s (1989) alternative categories can be applied to ICT as follows:

- *The citizen’s situation*: categories of the situations in which a citizen attempts to use ICT (i.e. restraints and barriers, power and constraints)
- *Gaps in sense-making*: categories of the gaps in information and communication that prompt a citizen to use ICT to seek information (i.e. characteristics or dimensions of self and others)

- *Citizen-defined purpose*: generic categories of how citizens use ICT to move through situations (i.e. to get ideas, to acquire skills, to be heard)
- *Information-using strategy*: categories of strategies for seeing and using information preferred by a citizen at a specific moment (i.e. browsing, formatting, indexing, citing, skimming)
- *Information values*: categories of the criteria by which citizens evaluate information (i.e. timeliness, accuracy, touchability, newsiness)
- *Information traits*: categories of how citizens would like the information presented (i.e. qualitative or quantitative, hard or soft)

McIver and Prokosch (2000) explored using Dervin's "sense-making" approach in a fieldwork setting to study information-seeking behaviour in a low-income community. Their findings suggest that qualitative research that investigates how citizens make sense of information is a promising approach for ICT development.

Seniors and ICT will use an approach that integrates these perspectives

Social science research that integrates citizen needs, citizen capabilities, how citizens make sense of information, and how they engage with ICT, will be the basis of ICT development as part of the Seniors and ICT research project.

4: Overview of aging in place

The previous chapter outlined the approach to technology development adopted by the project. This new approach begins by understanding citizen needs. This chapter reviews the most current research on the needs of senior citizens related to aging in place.

Six core needs are associated with aging in place

Research on seniors has identified six core needs related to aging in place:

- Financial security
- Health and health care
- Social communication
- Housing and supportive services
- Safety
- Transportation

Financial security is critical to seniors' activities and the services they rely upon – to a significant extent, what seniors can do is determined by how much money they have (Feldman and Oberlink, 2003). Similarly, good health and access to appropriate, reliable and affordable health care is required to maintain independence and participate in many activities that give seniors pleasure.

Social communication includes networks with informal caregivers such as family, friends and neighbours as well as participation in community, education, cultural and other productive activities. Social communication provides emotional and practical support as well as keeping seniors connected with their communities (Feldman and Oberlink, 2003). Social engagement by seniors may also delay the decline of their cognitive functions (Zunzunegui et al., 2003).

Staying in their own homes and having access to support and services to adapt their homes is another central need for seniors aging in place. The home has been the focus of a range of medical and rehabilitative alterations and adjustments that make it possible for seniors to live at home – such as expensive alterations to the physical home structure (widening doors, building ramps), to installation of special equipment (grab bars) to simple changes such as rearranging furniture – as well as more complex alterations such as smart homes technologies (Gitlin, 2000).

Seniors need to feel secure and safe at home and in order to leave their homes and engage in social activities. As well, they need access to affordable transportation in order to engage in social activities and access many social services.

Environmental gerontology is the study of seniors in their living environments

Environmental gerontology, a multi-disciplinary research field with a 40-year history, is the study of the relationship between elderly persons and their socio-spatial surroundings.

Its specialists include researchers from psychology, sociology, geography, economics, demography, gerontology, and architecture and urban design (Lawton and Eisdorfer, 1973; Gitlin, 2003; Wahl and Weisman, 2003).

Theories developed by environmental gerontologists aim to predict why some residential settings more than others fit the needs and abilities of seniors and contribute to improved quality of life. The idea is that seniors find it better, more enjoyable, easier, and less costly to grow old in some places than others (Golant, 2003).

This approach explores why senior citizens move from their home

In Canada, most senior citizens live out their lives in the homes they lived in at retirement age. Until recently, a decision to move after retirement was a choice between living in a more desired location or with family, or living in a health-care institution. Increasingly, a third option is a home in a continuing care retirement community (CCRC) that offers independent living close to health-care facilities.

Using an environmental gerontology framework, a considerable amount of research has been conducted on the moves made by senior citizens after retirement. A range of models to explain these moves have been developed (Krout et. al, 2002). Widely accepted models include the push-pull models which describe how certain factors “pull” seniors to new living environments while at the same time other factors “push” seniors out of their homes.

Another environmental gerontology model describes three types of moves that seniors will typically make: a move to a new location with better amenities and friendship networks, typically made by young and healthy retired people; a move to live with or near informal caregivers, typically made by individuals who become frail; and a move to a health-care institution, typically made by individuals whose health has deteriorated to a point where informal care is no longer enough (Litwak and Longino, 1987).

Seniors move for a range of push and pull reasons

Both push and pull factors include person-oriented factors (e.g. maintaining independence, maintaining health, functional disabilities), physical environment-oriented factors (e.g. living in a safer place, a warmer place, a nicer place, a less-expensive place, a lower-maintenance place), social environment-oriented factors (e.g. living closer to friends, closer to family, closer to cultural facilities) and other external or societal aspects (e.g. expire of lease) (Oswald et al., 2002).

There is considerable evidence that the pull and push factors are influenced by socio-economic factors such as age, gender, education and income as well as cultural factors. Individual attitudes and personal experiences – such as a strong emotional attachment to a home or a personal history of many significant moves – can also be strong determining factors.

One of the few studies in Canada on this topic found that rural seniors are institutionalized at a faster rate, a situation related to greater needs for care, unavailability of informal care, or an over-supply of nursing-home beds in rural areas (MacKnight et al, 2003).

Social gerontology highlights the social structures of aging

Social gerontology has been the focus gerontology research in Canada (Chappell, 2001). This research has focused on four areas: inequality, population aging and the social construction of crisis; family relations and caregiving; work, retirement and income security; and health, health care systems and health policy.

The main value of the sociological approach to research on aging has been the ability to make the connections between individual seniors and their broader social surroundings. The sociological perspective looks at relationships between the private and the public, such as an individual's decision to retire and public pension policies, or linking an individual's decision to age at home with community and health support structures (Chappell, 2001).

By combining the two perspectives of environmental and social gerontology, research can focus not only on the needs of individual seniors related to aging in place but also on the broader social structures related to the decisions that seniors make about meeting their needs.

Seniors need support to address these needs

In Canada, considerable research has concluded that seniors need support in order to stay in their homes as long as possible. Stewart et al (2001) highlighted that support needs are particularly acute for seniors with disabilities who may suffer loneliness and isolation. Support interventions can reinforce functioning and social structures as well as develop new skills, enable successful coping strategies and alleviate social isolation. In addition, group support interventions can optimise existing social support networks or create new networks for seniors at risk of social isolation (Stewart et al, 2001).

An analysis of gerontology research in Canada found that sociological research on support networks for seniors has been a major focus (Chappell, 2001). The analysis concluded that the next step in this research is to understand how to support families, how to create supportive communities, and how to interact with the formal healthcare system. More research is needed on the support methods that are supportive, for whom, and under what circumstances, with a particular emphasis on group activities in which seniors participate, such as volunteering (Chappell, 2001).

Informal caregivers are seniors' core providers of support

Informal caregiving has been highlighted in numerous studies as an important aspect of seniors' lives in Canada. Spouses, children, friends and neighbours provide the vast

majority of care to seniors. Estimates suggest that between 80 and 90 percent of care for frail, ill or disabled seniors in Canada is provided by informal caregivers (Wiles, 2003). Most of this care is provided by women (wives and daughters), and until recently it was unacknowledged by policy-makers primarily because it was unpaid and delivered in an informal setting (Chappell, 2001).

In Canada, health care provision is shifting from formal and institutional care to informal and community care. In this context, informal caregiving has become even more central to seniors' lives. However the needs of caregivers receive little support in the health care system, which focuses on the needs of individual clients rather than their informal care networks (Denton, 1997). Caregivers have a range of complex needs, including information needs related to the entitlements and supports available for seniors (Wiles, 2003).

An American study found that the ability of caregivers to provide support for seniors at home is influenced by a number of variables, including the caregiver-senior relationship, the values of the caregiver, and their coping resources and strategies. Across the US, a range of technology-based interventions are underway to enable caregivers to access formal and informal support services (Czaja et al, 2000).

Developing ICT that meets these needs is the focus of the project

The Seniors and ICT project will continue to research the needs of seniors related to social communication and aging in place. Both social gerontology and environmental gerontology perspectives will be explored to understand these needs. Research has highlighted the importance of social support networks, in particular informal caregivers, to the well-being of seniors.

5: Social communication issues for seniors

The previous chapter described the social challenge of aging and place and discussed six core needs related to aging in place. Social communication – one of the six core needs - is the focus of the Seniors and ICT project. This chapter discusses a range of issues related to social communication by seniors.

Aging affects communication in five ways

Research on communication and aging has highlighted five ways that communication changes as people age. These changes vary greatly among seniors; not all seniors will experience similar effects. Four changes, described in Giordano (2000), are:

- Perception
- Cognitive interference
- Speed and time
- Motivation

Perception refers to changes in sensory functions. It is well-known that vision, hearing, smell and touch functions decline over time, especially after the age of 50. Hearing loss is especially prevalent – in the US of almost half of seniors have a hearing problem and for half of them, the associated communication difficulties limited their activities (Dalton et al., 2003). This decline in functionality can make seniors feel uncertain and concerned about missing the details of communication.

Cognitive interference relates to the ability to process irrelevant or excess information and affects the quality and style of communication. As people age, they lose the ability to ignore irrelevant information and screen out background noise and information. Compensating for cognitive interference includes reducing unnecessary noise and focusing the conversation on a single subject.

Seniors need more time to retrieve and respond to information. In verbal exchanges, seniors may have trouble understanding people who speak quickly. Compensating for speed and time changes includes slowing down the pace of communication, allowing more time for seniors to respond. Periods of silence can be useful to allow more time for processing information.

The fourth change is motivation. Seniors need to be motivated positively and actively when they attempt to communicate and engage socially. This can be accomplished by responding to all communication attempts without judging, which reaffirms the worth and dignity of the senior and encourages further communication.

A fifth change is opportunity. Seniors, especially after retirement, spend more time at home and less time engaging in communication with others outside their home. Using ICT may be one way that seniors can regain opportunities for social communication with people outside their homes.

Seniors have different levels of communication associated with levels of risk

Chatman (1992) explored the information and social worlds of women living in a retirement community in the US. Her research suggests that seniors have communication needs that lead to sharing information on three different levels.

The first level is sharing general information that can be exchanged with no risk involved. This information is freely exchanged by seniors with their casual acquaintances and neighbours. This information is produced from common experience, such as being a senior, being a wife, watching the same TV programs, sharing the same religious upbringing and so on. Sharing this information is not perceived to be risky and provides a useful source of everyday conversation.

The second level of information sharing is selective, because there is a perceived element of risk. When sharing this information, seniors are concerned about maintaining their social standing. Information that may compromise their social standing cannot be freely shared with neighbours and casual acquaintances and is reserved for family members. Information on this level includes financial and legal concerns, some health concerns, and difficulties with neighbours.

The final level is secret information. This information is shared confidentially with the few persons considered by the senior to be advisors or caretakers, typically a lawyer, doctor or minister or priest, who are ethically bound to keep this information secret. Information on this level includes a problem that the senior cannot resolve alone, such as a self-realization by a senior that they are no longer capable of maintaining their independence.

Seniors have three broad areas of needs related to social communication

The ICF classification system of functions and associated needs – discussed in a previous chapter - describes three broad areas relevant to social communication (WHO, 2001):

- Communication
- Interpersonal interactions and relationships
- Participation in community, social and civic life

Communication needs include verbal and non-verbal messages

Seniors have communication needs ranging from reading and giving body language to reading newspapers and having telephone conversations. The WHO (2001) has identified seven types of communication functions and needs, listed below:

- Comprehending spoken messages – includes comprehending literal and implied meanings of messages in spoken language

- Comprehending non-verbal messages – includes comprehending the literal and implied meanings of messages conveyed by gestures, symbols and drawings
- Speaking – includes producing words, phrases and longer passages in spoken messages with literal and implied meaning
- Producing non-verbal messages – includes producing body gestures, signs, symbols, drawings and photographs
- Conversation – includes starting, sustaining and ending a conversation; conversing with one or many people
- Discussion – includes starting, sustaining and ending an examination of a matter with one person or many people, in formal or casual settings
- Using communication devices and techniques – includes telecommunication devices and other mediated communication techniques and devices

Seniors have a wide range of interpersonal interactions and relationships needs

Until several decades ago, it was believed that seniors were socially isolated and lonely. Since that time, there has been considerable social science research on the strong ties and relationships that seniors have, including marriage and sexual relationships (Mares and Fitzpatrick, 2004), relationships between grandparents and grandchildren and between siblings (McKay and Caverly, 2004), and between friends in later life (Rawlins, 2004). The WHO (2001) has identified five types of interpersonal interactions and relationship functions and needs, listed below:

- Basic interpersonal interactions – includes showing respect, warmth, appreciation and tolerance in relationships; responding to criticism and social cues in relationships; and using appropriate physical contact in relationships
- Complex interpersonal interactions – includes forming and terminating relationships; regulating behaviours within relationships; interacting according to social rules; and maintaining social space
- Informal social relationships – includes friends, neighbours, acquaintances, co-inhabitants and peers
- Family relationships – includes parent-child and child-parent relationships, sibling and extended family relationships
- Intimate relationships – includes romantic, spousal and sexual relationships

Seniors have many needs related to community, social and civic life

Feldman and Oberlink (2003) have described how healthy seniors need to be connected to communities and how healthy communities need the participation of seniors. Other researchers have described how seniors are active in community leisure activities and political life. In the US, seniors are more likely to be registered to vote and to vote than the younger generations (Holladay and Coombs, 2003). The WHO (2001) has identified five types of functions and needs related to community, social and civic life:

- Community life - includes engaging in all aspects of community and social life, such as engaging in charitable organizations, services, clubs or professional social organizations; engaging in rites or social ceremonies
- Recreation and leisure – includes engaging in any form of play, recreational or leisure activity
- Religion and spirituality – includes engaging in organized religion and spirituality
- Human rights – includes enjoying all nationally and internationally recognized human rights
- Political life and citizenship – includes engaging in the social, political and governmental life of a citizen; having legal status as a citizen and enjoying the rights, protections, privileges and duties associated with that role

There are many cultural differences related to aging and social communication

“Culture” refers to the ideas and experiences of a group of people that are transmitted from generation to generation. The concepts of “aging” and “social communication,” like most other concepts, are understood and manifested in different ways by different cultures.

Pecchioni et al. (2004) outlines some of these cultural differences. For example, in most Western cultures, people are socialized to believe in the importance of liberalism – individuals capable of making rational choices of their own choosing – and social communication is oriented toward individual choice. In contrast, in many Eastern cultures, people are socialized to believe in the importance of achieving group or collective goals in harmony with others in the same group.

In some cultures, the age of a group member is very important in determining social communication processes; in others it is less important. In some cultures, aging is something to be feared; in others it is seen more positively. Relationships and social communication between young and old are culturally shaped and determined, as they are between women and men.

These cultural differences become very important when developing ICT for social communication, because seniors from different cultures will adopt, use and adapt technologies in different ways. Canada is a multi-cultural society, and experiences of using ICT for social communication will vary among Canadian seniors with different cultural backgrounds. For example, Kanayma, (2003) found that Japanese seniors use the Internet to share haiku poetry.

All these issues are relevant for developing ICT for seniors

The ways that communications change with the aging process, the different levels of information that seniors share, their various social communication needs, and the cultural context of this communication are all concerns for the Seniors and ICT project. The ongoing research and technology development will continue to be focused on these social communication issues experienced by seniors.

6: ICT for social communication by seniors

The previous chapter outlined the range of seniors' needs related to social communication. This chapter discusses research related to the experiences of seniors using ICT for social communication and aging in place. The discussion includes the social, cultural and political context in which they live and use technology.

Television is by far the most popular ICT for seniors

Seniors watch television more than any other age group. A study in Winnipeg found that watching television is the most popular leisure activity for seniors (Strain et al., 2002). Studies of seniors in the US and Germany found that by far, seniors spend most of their time at home, and watching television is their single most time consuming activity (Moss and Lawton, 1982; Horgas et al., 1998).

It is widely accepted that time spent watching television is time not spent socializing with family, friends and neighbours (Nie, 2001). Therefore, it could be argued that television has had a negative impact on social communication for seniors.

On the other hand, interactive television applications can provide new opportunities for seniors to improve social communication, given that seniors are very comfortable and familiar with using televisions. Current television use includes watching local cable television channels that provide community information about socialization opportunities. Seniors can also use televisions to access the Internet, although this activity remains marginal and is largely confined to looking up information rather than social communication.

A range of devices are available to help seniors control their television equipment, including universal remote controls, remote controls with big buttons, those that can be custom labelled, and those that limit the number of buttons (Steggles and Leslie, 2001).

Time spent listening to radio may decrease with age

After television, the radio is the ICT that seniors use most. However in the US, radio use decreases with age (Robinson, 2004) and the same may be true in Canada. Almost every Canadian home has a radio. Unlike television, however, a significant level of radio use occurs outside the home, primarily while in a vehicle. Given that seniors spend less time in cars than younger age groups, they spend less time listening to radio. There are gender differences in radio use: while both women and men listen to news and weather information, few women listen to sports on radio.

Listening to radio over the Internet is an activity that is becoming more popular with increased penetration and lower cost of broadband. No research has been published to date on seniors' use of radio via the Internet.

Citizens band radio (CB) is very popular among seniors in certain areas of Canada, especially rural areas. CB is an interactive radio system with social communication functions. However no research has been published on seniors' use of CB.

Telephony has had the greatest positive impact on social communication

Historically, telephones have been the ICT with the greatest positive impact on social communication – having a telephone allows seniors to stay connected with family, friends and neighbours (Haddon, 2000). Widespread telephone use transformed home nursing and home care for seniors in the middle of the last century (Buhler-Wilkerson, 2001).

Services such as call display, telephone answering systems and voice mail have been very useful for seniors, many of whom lead busy lives. However the cost of some of these services may be prohibitive for seniors on a low income, and some are difficult to use and require training (Ryan, 2001). Seniors experience difficulties seeing the buttons or numbers on the telephones, hearing the ringer or the incoming voice, holding the handset, and they may find it difficult to remember the telephone numbers (Steggles and Leslie, 2001).

Specific devices and services to improve ease of telephone use include:

- The Ameriphone Photophone – memory buttons identified by a photograph of the person the phone number belongs to
- A Logitech Big Button Speakerphone – large buttons with good contrast, eliminates the need to use a handset
- Ameriphone ER telephone – enables the user to activate a remote pendant to automatically call emergency contacts and enables the responder to speak to the senior
- Ameriphone XL-40 telephone – increases the volume and has a loud ringer and ring flasher (Steggles and Leslie, 2001)

A group of Canadian researchers studied a telephone support intervention for senior women with disabilities in Nova Scotia (Stewart et al, 2001). They found that the seniors who participated in the telephone support project experienced decreased support needs, diminished loneliness, and enhanced coping. Some of the key success elements were not technical but social: the selection, training and support of peer and professional leaders and the control of the discussions by the older women themselves.

A study in Sweden found that although seniors with dementia use the telephone for social communication with family and friends, they also experience considerable difficulties and avoid using the telephone. Challenges for these seniors include knowing how to look up numbers in a directory, remembering which numbers to call, or knowing what identity a certain name or number represented. Some are not able to consistently identify the

telephone and confuse it with another device such as a television remote control. The study questioned the common assumption that seniors with dementia are capable of living alone and relying on a telephone for social communication and security (Nygard and Starkhammer, 2003).

A study in the US found that an automated telephone-based interactive voice response system (IVR) providing information to and opportunities for communication among caregivers of people with dementia was useful for the wives of men with dementia. The system was particularly helpful to women with few caregiving skills and high anxiety. The researchers concluded that telephone-based systems had future potential for women caregivers (Mahoney et al, 2003).

However an earlier study in Ottawa found that many IVR systems are badly designed and do not meet the communication needs of seniors (Dulude, 2001). Another US pilot study concluded that automated telephone systems can be disturbing and overwhelming to seniors and suggested that passive, web-based systems were better for automated home care for seniors (Miller et. al, 2004).

Little research has been conducted on wireless applications for seniors

Although wireless telephony and broadband is currently the focus of intensive research and development effort internationally, little research has been conducted on applications for seniors. Few published studies were found related to wireless telephony or broadband for applications that would assist seniors to age in place.

Through focus groups with seniors, a Finnish research team identified a need for a range of wireless applications for seniors, including: a mobile shared workspace, a location-based system for encouraging spontaneous meetings, location-based messaging, location-based route guide, and a “friendship manager” to manage text messages among friends (Kankainen and Oulasvirta, 2003).

The Utopia project in Scotland is developing methodologies for ICT design for seniors. The project researchers have conducted focus groups with seniors leading to the design of a wireless location-based system for navigation (Goodman et al., 2004).

Wireless telephony is not as popular in Canada as it is in many European countries, where mobile phones are used more frequently than fixed-line telephones. As noted in a previous chapter, in 2000 only 18 percent of seniors in Canada owned a cell phone. A report from the EU’s SeniorWatch survey pointed out that using mobile telephones have in some cases replaced older assistive technology devices because mobile telephones are easier to use (Ekberg, 2002). However seniors may find the small buttons and multiple features on mobile telephones difficult to use.

The SeniorWatch survey identified mobile telephony and handheld devices as having considerable potential for seniors (Ekberg, 2002). The major mobile telephony companies

have developed products for use by people with disabilities that could also be useful for seniors, including:

- The inductive loop, which links mobile telephony with hearing aids
- Voice dialling, for users who cannot use the dial buttons

Many seniors use assistive devices to improve communication

As discussed in a previous chapter, the term “assistive device” refers to a device used to increase, maintain or improve functional capabilities of people with disabilities. Seniors acquire 75 percent of all assistive devices (Koncelik, 2002). Some assistive devices could be classified as ICT for improved communication – hearing aids are common ones.

Assistive devices to improve reading include talking books on audiotape and closed-circuit television enabling the user to magnify a document and view it on a television screen (Ryan et al., 2001). Computer-based assistive devices for reading include computer screen magnification programs, screen reading software, and scanners and optical character recognition and reading software (Petty, 2001).

A stigma is attached to assistive devices. Seniors accept devices that are completely hidden from public view but have difficulty accepting those that change their appearance because it makes their disability publicly visible (Gitlin, 2002). The stigma factor has been a barrier to the more widespread adoption of many assistive devices.

Among the major benefits of assistive devices is a sense of a return to normalcy. Seniors use assistive devices to regain a sense of well-being and control over their environment and to live “normal” lives (Gitlin, 2002).

Levels of Internet use by seniors are increasing

Until recently, the low level of Internet use by seniors led to speculation that they were “technophobic” - afraid of computers or new technology. That argument has been silenced now that the seniors population online is growing.

As discussed in a previous chapter, in 2000, only 12 percent of seniors were connected to the Internet. The latest available research suggests that 35 percent of Canadian seniors use the Internet, with 60 percent never having used it. Twenty-two percent of all seniors use it daily (EKOS, 2004). These levels of use put Canadian seniors well ahead of seniors in most other countries for Internet connectivity.

A major study in Atlantic Canada found that seniors will use the Internet and other information and communication technologies – if they are relevant and meet their needs and if they are introduced to seniors in an appropriate and supportive manner (Jessome et al., 2001). Seniors are not resistant to trying new health information technologies, such as web-based information (Wagner and Wagner, 2003). The need for social policy measures

to increase the numbers of seniors online has been identified in Canada (Cubberly et al., 1999) Australia (Williamson et al., 2001) and Europe (O'Donnell, 2003).

In Canada, almost 95 percent of senior Internet users access it from home, with few using public access centres (EKOS, 2004). Similar figures for the UK have led to the suggestion that development of Internet programmes for seniors should focus on home use (Selwyn et al., 2003).

Does Internet use increase social communication by seniors?

A study of frail older seniors in Montreal found that most participants in an Internet training and support project experienced a variety of benefits, including strengthening their social networks by email (Straka and Clark, 2000). Email communication was the most popular use of the Internet by seniors in an American study (Hilt and Lipschultz, 2004), and a study in Scotland (Goodman et al., 2003). Other studies have highlighted the social communication benefits of the Internet for seniors (Kanayma, 2003; Wright and Query, 2004).

However the research is conflicting. It was noted earlier that watching television takes time away from socializing with friends and family. Major studies on the Internet and sociability have come to very different conclusions on whether the Internet is similar to television in this respect.

One analysis of this conflicting research highlighted that the Internet, unlike the television, is user-driven, and it is less often used than the television as a group activity. This analysis concluded that although email offers a substantial and meaningful option for interpersonal connectivity, overall the Internet has a much more isolating potential than the television (Nie, 2001).

However another perspective is that communication on the Internet and especially Internet communities can be particularly beneficial to seniors who are experiencing a decline in their social interactions (Kanayma, 2003). It is also possible that seniors are using the Internet for social communication at times when they normally did not engage in such activities, such as late in the evening. From these perspectives, the Internet can offer great potential for seniors at home who would like to remain socially engaged. Another perspective is that even if Internet use does not increase social communication overall, it can have related benefits such as increased feelings of mastery and empowerment (White et al, 2002).

Perhaps the best way to resolve this debate is to say that the Internet can both increase and decrease social communication for seniors. The Internet supports different types of mass media – such as email, discussion lists, Web pages and so on. As such, the Internet may be used similar to other mass media by seniors. Seniors use mass media for many reasons, including both as a substitute for social interactions and a means of improving social interactions (Bleise, 1982).

Seniors' communities exist on the Internet

Most seniors' communities on the Internet are email-based. Seniors have created many formal and informal email-based communities, from large email discussion lists to small email groups of friends and family. At the time of writing, Yahoo! Groups – the largest portal for email discussion lists on the Web - listed 316 email groups for seniors and 114 for grandparents.

There are also a number of Web-based communities for seniors. They include:

- SeniorNet (US) - <http://www.seniornet.org/>
- Wired Seniors (US) - <http://www.wiredseniors.com/>
- Third Age (US) - <http://www.thirdage.com/>
- Senior Site (US) - <http://www.seniorsite.com/>
- Seniors Network (UK) - <http://www.seniorsnetwork.co.uk/>

One of these online communities – SeniorNet in the US – has been analyzed by researchers (Wright, 2000). The analysis found that seniors are happier with their SeniorNet networks the more time they spend on the network. The types of relationships they develop online are best characterized as companionship networks, rather than social support networks. In addition, greater use of the network was linked to lower perceived life stress.

Governments at both federal and provincial level in Canada are developing Web portals for seniors, some of which have functions aimed at improving social networking. These Canadian public websites include:

- Seniors Canada On-line – www.seniors.gc.ca
- NB website for seniors - <http://www.gnb.ca/0017/Seniors/index-e.asp>
- InfoPEI - <http://www.gov.pe.ca/infopei/Seniors/index.php3>
- Ontario Senior Secretariat - <http://www.gov.on.ca/citizenship/seniors/english/guide.htm>

A range of products and design strategies exist to help seniors use the Internet

Vision changes associated with aging imply design changes in Web interfaces for seniors. Research and strategies aimed at improving website design and usability for seniors is a well-developed area. The National Institute on Aging in the US has taken a lead, publishing a comprehensive report on web site accessibility guidelines for older adults (Morrell et al, 2001). The Institute and the National Library of Medicine in the US recently launched a “talking website” with health information aimed at encouraging seniors to use the Internet. The website URL is:

- NIH SeniorHealth - <http://nihseniorhealth.gov/>

Using computers can present challenges to seniors. For example, many seniors are not capable of double-clicking a mouse – which requires holding the cursor steady and

clicking twice within .125 seconds (Koncelik, 2002). Extended use of video display terminals can cause transient eye problems for seniors, who have more eye problems as they age. The decrease of muscle strength experienced by seniors makes them more susceptible to repetitive strain injury (Berliss-Vincent, 2001).

Seniors with disabilities have particular needs when using computers and the Internet, and a range of products have been developed that seniors find useful (Williamson et. al, 2001), including:

- Intellikeys – a large keyboard with a selection of overlays appropriate for different disabilities.
- Opera browser – An open source browser that is particularly useful for people with sight disabilities.
- EIA (Enhancing Internet Access) system – provides a touch screen, simplified browser and online keyboard and offers flexible assistance for a range of disabilities.

Videoconferencing and videophone remain marginal ICT for seniors

Very few seniors have used video communication technologies and very little research has been conducted in this area. The few studies have focused on applications for e-health rather than for social communication. One such study found that video-telephony for telenursing is well accepted by seniors, especially as they become more familiar with the technology (Arnaert and Delesie, 2001). Another study found that nurses working with family members who were informal caregivers could use video-phone communication effectively with cognitively impaired seniors.

A pilot project run by the Canadian Hearing Society in Sudbury led to the more widespread use of IP videoconferencing in major centres across Northern Ontario. The Society uses the technology to provide services for deaf and hard of hearing people in remote locations (Allen, 2001). Along similar lines, a video-telephony project in Finland for deaf people uses existing video-telephony technology to allow people to communicate via sign language with each other (Ekberg, 2002).

A pilot video-telephony support service for seniors in Germany was in operation for several years in the late 1990s. The service was operated by a local agency that provides services to seniors and used commercially-available equipment provided by the public telephone company. One outcome of the pilot was that the social communication aspects of the service – the opportunity for seniors to interact with each other through video-phone – proved to be a popular activity for seniors (Empirica, 2001). The future of the service was limited by the cost, which was prohibitive for the local social services provider.

Following on from the German pilot, a California research team is developing a videoconferencing system designed to improve social communication between seniors

and their distant friends and family (Sachs et al, 2003). The system, intended to be a commercial product, uses the conventional technologies of television and telephone with a set-top box and remote device. The system is currently in the prototype stage.

Multimedia ICT has been developed for seniors and caregivers

It was noted earlier that a range of Internet-based information resources have been developed for seniors. Information resources have also been developed for CD ROM format. A research team in Northern Ireland developed a CD ROM-based multimedia application (text, sound and video) containing information resources to help the caregivers of seniors. This product, intended for use within the formal and community health care systems, is aimed at helping seniors remain independent at home (Chambers and Connor, 2002).

Sensory and contextual ICT applications for seniors are in development

The research areas of “computational perception” and “emotional design” are concerned with sensory and contextual aspects of product design (Norman, 2004). A research team on computational perception in the US is designing context-aware products to assist seniors aging in place. They include a “digital family portrait” that uses sensor information from the home of a senior to change the appearance of a picture frame in the home of a family member. The picture frame – framing a picture of a senior – thus relates contextual information to the family member (Mynatt et al., 2000).

Seniors are engaged with a wide range of ICT

The review of published research in this chapter illustrates that seniors are engaged with many types of ICT - from television, radio and telephones to wireless applications, assistive devices and the Internet as well as applications with more marginal use. The Seniors and ICT research team sees value in exploring any of these areas for technology assessment and applications development.

7: Other ICT for seniors

This chapter outlines some ICT applications that may meet some of the other needs of seniors that were discussed in an earlier chapter. The reasons for the commercial success (or otherwise) of the products are also discussed.

ICT can meet healthcare needs both directly and indirectly

ICT has been applied to meet health and health care needs of seniors in many different ways. In this section a variety of applications are described which include systems that monitor a user's health as well as systems that directly improve a user's health by aiding recovery from brain trauma.

Rapid progress in sensor and communication technology has led to much interest in the concept of home health monitoring (Korhonen, Parkka and Gils, 2003; Noury et al., 2003; Ogawa and Togawa, 2003; Rialle et al, 2002). The hope is that sensor technology incorporated into the home, coupled with servers to process the raw data, is used to monitor the well being of the occupant(s).

The sensors could be simple pressure pads which detect movement around the home to wearable health sensors which can capture physiological data. The wearable sensors could be in the form of, for example, a ring (Asada et al, 2003). Using data collected by sensors it will be possible to alert care givers to a fall, alert patients to the potential onset of a problem, or pre-warn emergency services to the condition of a patient.

The successful uptake of such systems is largely dependent upon two factors: cost and aesthetics. It is hoped that although the systems may themselves be expensive they will still be a cheaper alternative than institutionalization. Furthermore, as discussed in an earlier chapter, the aesthetics of the system must be appropriate so that the users of such systems do not feel that they are being labelled as inadequate by the use of obviously assistive or seemingly institutional technology regardless of the benefits.

The NeuroPage system (Wilson et al, 2001) uses standard pagers to provide non-progressive, brain trauma victims with reminders during their recovery. The use of the system enables the users to establish a routine and in many cases a level of independence. The system is typically used for a period of two to three months after which the user is usually able to perform at a better level than would have been achieved without the use of the system.

The system is available in the UK at a cost of £60 (approximately \$145 CDN) a month. This cost – which is often met by the local health authority or, if available, private insurance – is low enough that the uptake of the system is high. Furthermore, trials of the system showed that the majority of the users were happy to use it because it used everyday technology which did not identify the user as needing the help the system provided.

MemoPage, an updated version of NeuroPage which allows users to respond to reminders is currently undergoing trials (Szymkowiak et al., 2003). By detecting user responses – or the lack thereof – the system is able to provide alerts to caregivers and/or emergency services if an alert is missed.

ICT has been used to provide users with information about the different choices they have when buying food (Intille et al, 2003). A handheld computer equipped with a barcode scanner provides users with the ability to scan two items and then instantaneously view nutritional information about the two items. It is hoped that this system will enable the educational messages about healthy eating to be provided at the point of purchase and therefore affect the users' behaviour resulting in a healthier diet.

Researchers at MIT have used wearable computer technology to provide truly mobile ICT applications for healthcare (Pentland, 2004). One example of the type of application developed is the DiaBetNet game which helps children with diabetes learn about the disease and how to manage it. The game uses sensors that monitor the players' physical condition as they go about their daily lives and provide this high level feedback to the user. Players can gain points by accurately guessing the blood sugar levels of themselves and other players who are connected wirelessly. A four week trial showed that not only did playing the game improve the players' knowledge of diabetes but – perhaps as a result – the incidence of hyperglycaemia (high blood sugar) was significantly reduced.

Intel has been investigating how ubiquitous computing technologies can help seniors age in place (Dishman, 2004). They propose that ICT can be used to provide an infrastructure for *maintaining wellness* as opposed to curing illness. Intel's research is focussing on four main areas: promoting healthy behaviours; detecting disease early; ensuring patients follow treatment plans and supporting informal care giving. Intel hopes that such systems will encourage seniors to maintain physical fitness, nutrition, social activity and cognitive engagement so they can function independently in their own homes for as long as possible.

ICT has been incorporated into Smart Homes to help seniors age in place

Smart Home technology is ICT that has been designed to enable a home to react to its occupants' needs. Smart home technology can range from individual sensors for a particular need (e.g. a sensor which switches on a bedside light when the bed's occupant gets up: <http://www.enableproject.org/html/products.html>) to a house which is able to detect all the activities of the occupants - e.g. (Kidd et al., 1999). This section provides an overview of some of the smart home projects being undertaken with many of the applications of smart home technology covered in the health and safety sections of this chapter.

The MIT House_n project uses an apartment which is fully equipped with sensors which enable researchers to monitor the occupants' activities. The apartment is occupied by volunteers who have no contact with researchers as all the data is analysed off-site. Much of the project's research is focussed on how best to study users behaviour in a natural – as

opposed to a laboratory – setting (Intille et al., 2003). To this end, the project has produced three tools which enable researchers to study users' behaviour in their homes and workplaces. The context-aware experience sampling toolkit enables users to annotate sensor readings. The user is requested to provide additional information only when the system detects that an annotation is required, for example when the user is in a particular location. This means that interruptions are kept to a minimum but the annotation is still more accurate than that provided by diaries which can suffer through selective reporting and forgetfulness.

The second tool, image based experience sampling, is an alternative to the context-aware experience sampling toolkit which does not require the user to be interrupted. The system takes images which can later be annotated by researchers and the users, or both. The images provide the context for the questions asked by the researchers and can be annotated at a time convenient to the user. The disadvantage of this approach is that it requires the user to be in an area covered by the image capture system. The ubiquitous environment state-change sensor system is a collection of simple hardware sensors and associated software which can easily be deployed in home or workplace settings. The sensors passively collect data such as light switch operation or door opening. The data acquired by these sensors may well be used in conjunction with the self reported data described above.

An example of how House_*n* technology could be applied is by providing a *proactive health care system* that monitors healthy patients in their homes and motivates lifelong healthy living (Intille, Larson and Kukla, 2002). This prototype system monitors the house's occupants, asking health related questions at relevant times. It is hoped that by collecting sufficient contextual information it will be possible to predict the possible onset of problems such as coronary heart failure and therefore recommend the user see a health care specialist. It is hoped that this preventative medicine will, in the long run, be more economical than the current approach of curing the sick.

The Active Home Research Institute (AHRI) is a purpose built 5000 square foot home which is used as a research facility into smart home technology (Abowd et al., 2000). The Institute's main research interests are: designing interactive experiences appropriate for people – in particular older people - in an aware home environment; developing the building blocks to create highly distributed sensing and perception technology; addressing the software construction challenges of engineering a robust and reliable bridge between the designer's intent for interactive experience and the technology itself; and exploring the social, political, legal and economic benefits and concerns related to privacy and autonomy when services exploit awareness and knowledge of human activity within the protected space of a home.

An example of an interactive experience that AHRI is looking into are Digital Family portraits (Mynatt et al, 2001). These portraits use sensor technology in a senior's home to monitor the activities of the occupant(s) as well as general environmental conditions such as the weather. This sensor data is fed to a digital picture frame which surrounds a standard picture. The frame provides high-level information about the monitored senior's

activities and if located in, for example, an adult child's house can provide reassurance about the parent's well-being.

An example of the type of sensing technology AHRI is investigating is the smart floor (Orr and Abowd, 2000). This is a floor tile which is able to determine the user that is standing on it and therefore can provide the user's location and a sense of the user's activity. By detecting the footstep profile (or the unique profile of the force applied to the floor by the heel and toe while walking) the tile has been shown to distinguish between up to 15 users with a high degree of accuracy, regardless of footwear.

The AHRI has also developed a framework for judging pervasive technologies against social norms (Jacobs and Abowd, 2003). It is hoped that this framework will enable technology developers to determine how and why their systems test these norms. Although the framework does not provide definitive answers, it does provide the starting point for the discussion about how to reach these answers.

The Samsung Smart Home project (Park, Won and Lee, 2003) describes many scenarios of how smart home technology could be employed to make a user's home life a better experience. The project is primarily aimed at conceptualising how the technology could be employed rather than providing concrete implementations of such technology. Examples of the technology include the smart pen which can automatically translate underlined words; the smart bed which is capable of adjusting the environment so that is ideal for the occupant when they wake; a smart refrigerator which tracks stocks of foods and their expiry dates; and smart universal remote which automatically reconfigures its display to suit the device it is being pointed at.

As technology in the home becomes more widespread a side-effect is that the use of this technology becomes more complicated. This is evidenced by the range of devices such as televisions, microwave ovens and telephones which have an ever increasing function set but at the cost of decreasing usability. As ICT is incorporated into the home itself the difficulties in using this technology will increase.

One solution to this problem is the development of a natural language interface to household appliances (Yates, Etzioni and Weld, 2003). This work takes the experiences of building natural language interfaces to databases and shows how it could be applied to the control of household appliances. This would have several advantages: the user would be able to operate devices remotely; the devices could be operated hands-free; and multiple remote controls would not be necessary to operate multiple devices.

ICT can help seniors stay safe

The Safe and Sound system is a research project that employs Global Positioning System (GPS) technology to ensure that small children do not stray to far from their home (Marmasse and Schmandt, 2003). In the system two mobile phones equipped with GPS are employed with one given to the child and one to the parent. If child leaves the safe area specified by the parent an alert is sent to the parent's phone. By using absolute

location (the safe area) rather than relative location (e.g. the distance between the phones) the parent has more freedom to move around. A similar system which is commercially available is the Alzheimer's GPS watch (<http://www.gpslocators.com/gpslowaforal.html>) which is designed to be used to help locate Alzheimer's patients should they become disoriented.

The Bath Institute of Medical Engineering (BIME) produces several products designed to improve the lives of dementia sufferers. These products include a stove top monitor which will automatically switch off the gas supply if the stove is left unattended for a period of time and a bedside light which automatically switches on when the bed's occupant gets up. These products are commercially available.

Although they do not directly meet safety needs, memory aids help users function on a daily basis. One example of such technology – NeuroPage – has been described earlier. Another example of a memory aid is the MemoClip (Beigl, 2000). Unlike NeuroPage which uses time as the trigger for reminders, MemoClip uses location. Users are able to pre-programme reminders for specific locations. The reminders are presented on a small screen with a short audio alert when the user's MemoClip is detected in the appropriate location.

ICT can provide information to help with financial and transportation needs

ICT is able to support financial and transport needs of seniors by providing relevant information in a convenient fashion on the web. Such information includes timetables and Internet Banking websites. The use of embedded computers in, for example, ATM banking machines is a common example of how ICT can help users manage their financial affairs. Less obvious, although becoming just as popular, is the use of computers in cars. The onboard computers will manage tasks as varied as engine management and diagnostics; cabin temperature control and detecting obstacles when parking.

ICT meets a wide range of needs for many users

In this chapter many examples of how ICT can benefit users have been given. The examples range from relatively simple, single purpose applications to complex applications that are designed to meet many different needs of the users. The majority of commercially available applications fall into the former category with many research projects falling into the latter category. There are many reasons for this but the overriding concerns for an end user are cost and aesthetics. If the benefit of a system can be seen to be worth the financial outlay and the system does not appear to stigmatise the user then it is more likely to be commercially successful.

Annex: Statistical Profile of Senior Citizens and Baby Boomers in Canada

This Annex provides background data and information – a statistical profile – of senior citizens and Baby Boomers in Canada. This profile is essential in identifying special needs, other needs such as by gender, or by age group within the senior citizen cohort, and to identify trends and potential differences in this market with the Baby Boomer cohort, the demographic group that is rapidly approaching senior citizen status. Senior citizens are persons aged 65 years and over. Baby Boomers are persons aged 50-64, although some results referred to are for those aged 45-64. Realizing that there may be differences within the senior cohort and Baby Boomer cohort will enable much finer-tuned ICT applications to be developed, ones that will find a broader user group, and that will be malleable to a range of physical, communicative, and or cognitive or mental differences and vulnerabilities.

Information on the Datasets and Methods

Information for this profile was taken from the 2001 Canadian Census, the General Social Survey Cycle 14 2000, and the Survey of Household Spending (SHS) 2000, conducted by Statistics Canada and made available through the Data Liberation Initiative of the University of New Brunswick. General Canadian statistics available from Statistics Canada and tabular data from the Participation and Activity Limitation Survey (PALS) 2001, and the first report on the General Social Survey Cycle 16 2002 was also used. Surveys are referenced appropriately. Because much of the available raw data is relatively dated, where appropriate, information taken from confidential and more recent EKOS research has been used in a supplementary fashion. This information will identify further Canadian ICT trends for both cohorts.

Data from the 2001 Census: Population and dwelling counts are accurate and represent data collection on 100% of households. Other data collected on the “long form” of the Census is collected on a 20% sample basis of one in five households and the data is weighted to compensate for sampling. Data are collected on 100% basis in remote areas and on First Nations’ reserves. To ensure confidentiality, data totals are randomly rounded to a multiple of 5 or 10. As well, area suppression is also used to protect personal information. Area suppression is “the deletion of all characteristic data for geographic areas with populations below a specified size” (Statistics Canada, 2001).

Information is deleted for geographical areas when the following criteria are met:

1. If the data are calculated from 100% of the Canadian population, the data are suppressed if the total population in the area is less than 40 persons.
2. If the data are calculated from the 20% sample of the Canadian population, the data are suppressed if the total non-institutional population in the area from either the 100% or 20% databases is less than 40 persons.

3. Income distributions and related statistics are suppressed if the non-institutional population in the area from either the 100% or 20% databases is less than 250 persons or if the number of private households is less than 40.
4. The data are suppressed if the quality of data is considered inadequate due to incompletely enumerated Indian reserves and Indian settlements.
5. Suppression of data can be due to poor data quality or to other technical reasons.(www.statcan.ca)

It is important to note potential data quality limitations of the Census data and to point out that as the national census is such a huge undertaking and although standards are strived for, errors will inevitably occur. Statistics Canada (2001) defines several areas of errors incurred in the collection and processing operations and must be noted when basing conclusions on the data.

1. Coverage errors: occur when dwellings or individuals are missed, incorrectly enumerated, or are counted more than once. This includes both under-coverage and over-coverage.
2. Non-response errors: occur when responses cannot be obtained from households or individuals.
3. Response errors: occur when either the respondent or census representative records an incorrect response or uses the wrong response box.
4. Processing errors: occur at various stages of processing operations. These can include coding errors, data capture errors, and imputation errors.
5. Sampling errors: apply to the long form questions only and result from weighting up the responses to reflect the whole population.

Analysis performed on the Survey of Household Spending was done with the dataset weighted by household weight. The data was selected for full-year households only, as Statistics Canada suggests using only full-year household records for averaging annual expenditures.¹ A number of steps were taken to protect confidentiality, including rounding of income values. Although the SHS is representative of the Canadian population, it is important to note that the following groups of persons were not included in the survey: persons living on native reserves; persons living on crown lands; official foreign country representatives and their families; persons of religious and other communal communities; armed forces members living in military camps; persons living in senior citizen residences; persons living fulltime in institutions. Present analysis selected age groups 50-64 and 65 years and over to determine household communication assets and annual expenditures on such items. The sample size for the Baby Boomer age group totaled 3,494 and for the senior age group totaled 3,106.

The General Social Survey Cycle 14 collected data on access to and use of ICT. The target population included persons aged 15 years and over, but excluded residents of Nunavut, the Yukon and Northwest Territories, as well as full-time residents of institutions. The ten provinces were geographically stratified and samples were taken from each. The sample included 25,090 respondents, representing an 80.8% response

¹ Statistics Canada (2002). *User guide: Public-use microdata file, Survey of Household Spending, 2000*. Ottawa: Author.

rate. The Baby Boomer cohort totaled 5,113 and the seniors cohort totaled 4,752 in the sample.

When running analyses, the dataset was weighted by person weight. Survey weighting is necessary to account for any under or over-representation geographically, by age and sex, or by month of data collection. “National” comparisons are made in some sections of the report referring to the GSS 14. These “national” counts were taken from the full, weighted, dataset.

Cycle 16 of the General Social Survey collected data on 24,870 respondents aged 45 years. This survey excluded residents of Nunavut, the Northwest Territories, and the Yukon Territories, as well as full-time institutional residents. When weighted, the data represents one in 448 persons aged 45 years and older in the general population of Canada.

The public use microdata files are not yet available for the GSS Cycle 16, however, information for this report was taken from Statistics Canada tables (catalogue no. 89-583-XIE) and the first report from the data: *General Social Survey Cycle 16: Caring for an Aging Society* (catalogue no. 89-582-XIE).

The GSS Cycle 16 collected information on the aging population, characteristics of persons providing care as well as those seniors receiving both formal and informal care, determinants of health, and retirement plans and experiences (Statistics Canada 2002). The GSS Cycle 16 defines a care receiver as a person 65 years and over who received assistance in the past year with at least one task because of a long-term health problem. A care provider is defined as a person 45 years and over who provided assistance in the past year with at least one task to a care receiver suffering a long-term health problem. Caregiving tasks included help inside the house, such as preparing meals and cleaning up, and laundry. Outside tasks included such duties as house maintenance, personal care, transportation.

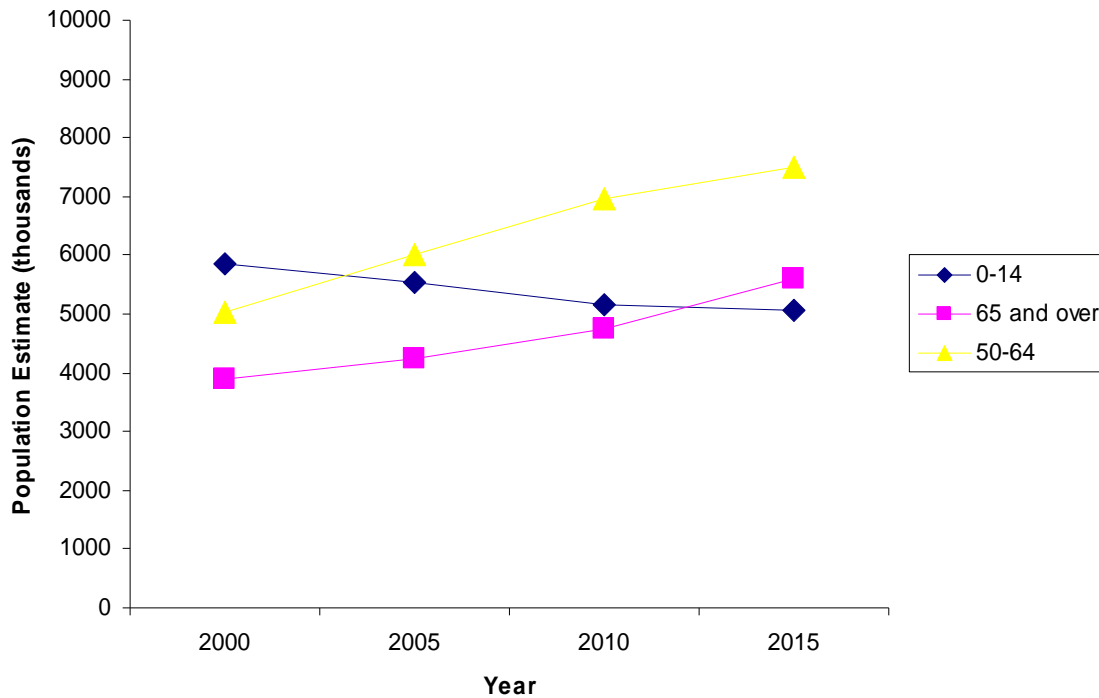
The Participation and Activity Limitation Survey 2000 has significant limitations. People living in institutions were excluded from the survey, as well as persons living in the Yukon, the Northwest Territories, Nunavut, and on First Nations reserves. PALS is a post-censal survey, which uses the national census to identify its sample population. This is a cost-effective method of data collection on a population that is geographically dispersed.

Contextual Profile of Seniors and Baby Boomers in Canada

The senior population in Canada is increasing

Canada has an increasingly aging population, while at the same time birth rates are decreasing. Further to this, the phenomenon of the “Baby Boomers”, which represents a large proportion of the population in Canada, is now on the verge of entering the senior citizen stage of the population. Figure 1 illustrates that persons aged 50-64 will outnumber those aged 14 and over by 2004/2005 and will continue to increase, far outnumbering that age group by the year 2015. Those persons aged 65 and over are predicted to outnumber those aged 14 and over by 2013 and will also continue to increase.

Figure 1: Projected Number of Seniors and Baby Boomers in Canada



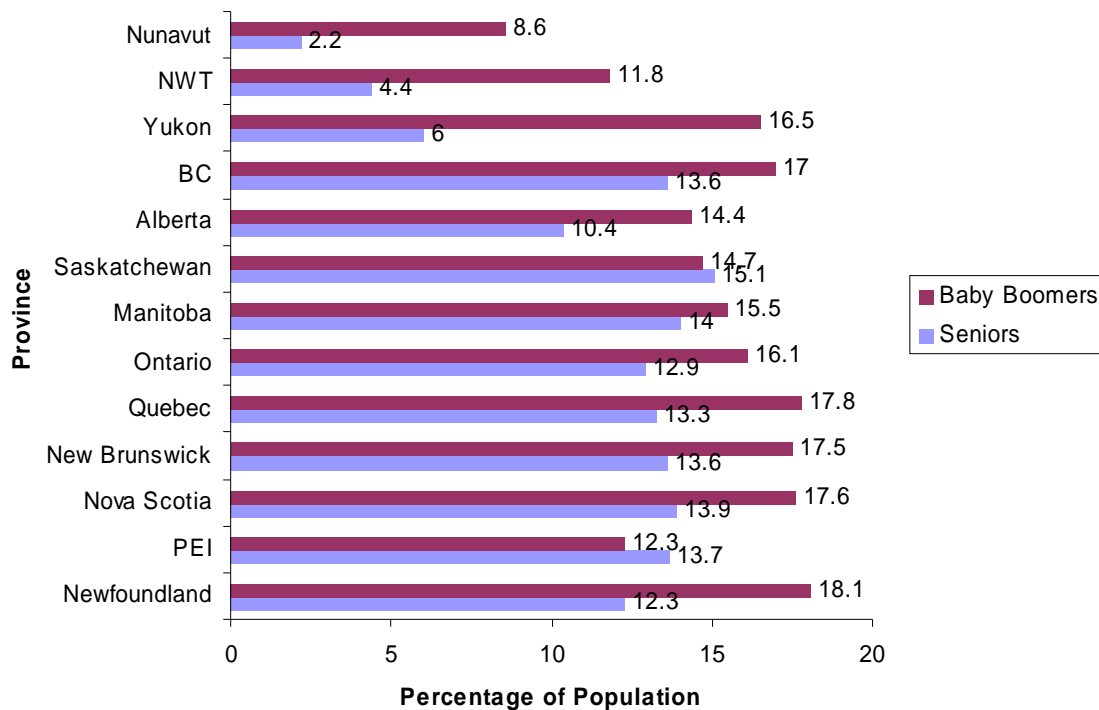
Source: Statistics Canada

Seniors represent 13 percent of the population of Canada

Proportionately, seniors make up 13% of the population of Canada, which is estimated at 31,629,677. Of this, 4,060,140 are aged 65 years and over, which represents a 12% increase from the 1991 Census. Baby Boomers make up 15.7% of the population of Canada.

The percentage distribution of seniors and Baby Boomers by province is comparable across Canada (Figure 2). The territories have the smallest proportion of seniors in their populations. While all of the provinces have similar proportions of seniors in their populations, Alberta has the lowest and Saskatchewan the highest. These figures do not reflect Native Canadians living on reserves. Newfoundland has the highest proportion of Baby Boomers, while Nunavut has the lowest. The Northwest Territories and Prince Edward Island have smaller proportions of Baby Boomers, but all other province are quite similar in distribution.

Figure 2: Percentage of Population in Canadian Provinces and Territories

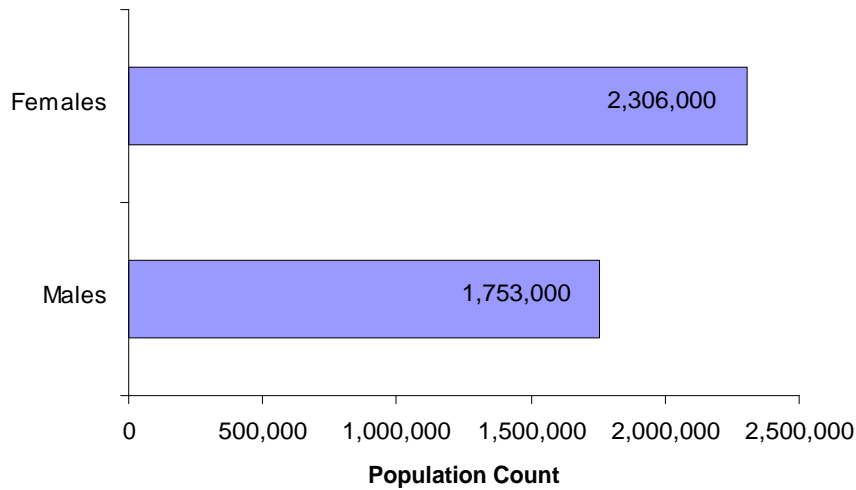


Source: Census 2000

Females far outnumber males in the senior citizen population

Approximately 1,753,000 males and 2,306,000 females aged 65 years and over live in Canada, and Figure 3a illustrates that proportion. There are clear gender differences in the senior population, with females being almost three times as likely to live alone at a later age (figures 9 and 10), being slightly more likely to indicate a physical disability (figure 14), and having a higher tendency to receive lower levels of income.

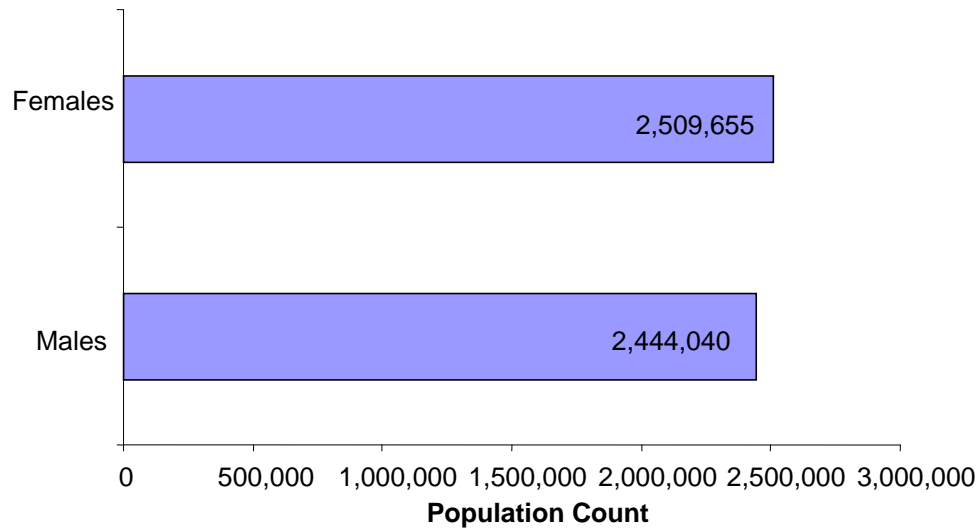
Figure 3a: Gender Differences in Senior Citizen Population



Source: Census 2000

As illustrated in Figure 3b, unlike the senior cohort of the population, there is little difference in numbers of males and females among Baby Boomers, in fact, in the Northwest Territories, Yukon Territory, and Nunavut, males outnumber females. However, females within the Baby Boomer cohort tend to have much lower levels of income than do men.

Figure 3b: Gender Differences in Baby Boomer Population



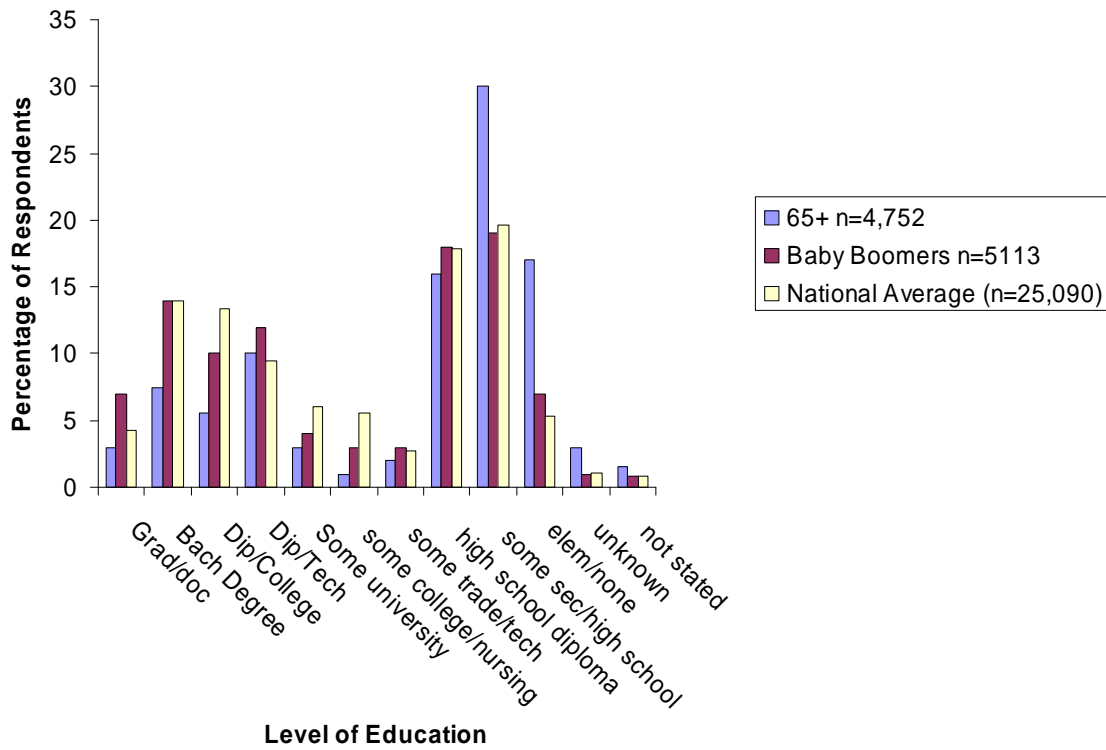
Source: Census 2000

Seniors have lower levels of education

Two of the major obstacles for using new communication technologies are skills and literacy (EKOS, 2004), and level of education is one important predictor of ICT use. Almost half of current seniors are considered to have low skills or to be unskilled based on their level of education. The majority of current seniors (63%) had high school or less, with about one in four (23%) reporting post secondary education (Figure 4). Almost half (47%) of seniors did not complete high school or only had elementary school education or no education (17%).

Baby Boomers tend to have higher levels of education, compared to both their senior counterparts and the national average. Data from the GSS 14 suggest that twice as many Baby Boomers as seniors have college diplomas (10%) or bachelor's degrees (14%). Furthermore, slightly more than twice as many Baby Boomers have graduate or doctorate degrees (7%).

Figure 4: Highest Level of Education

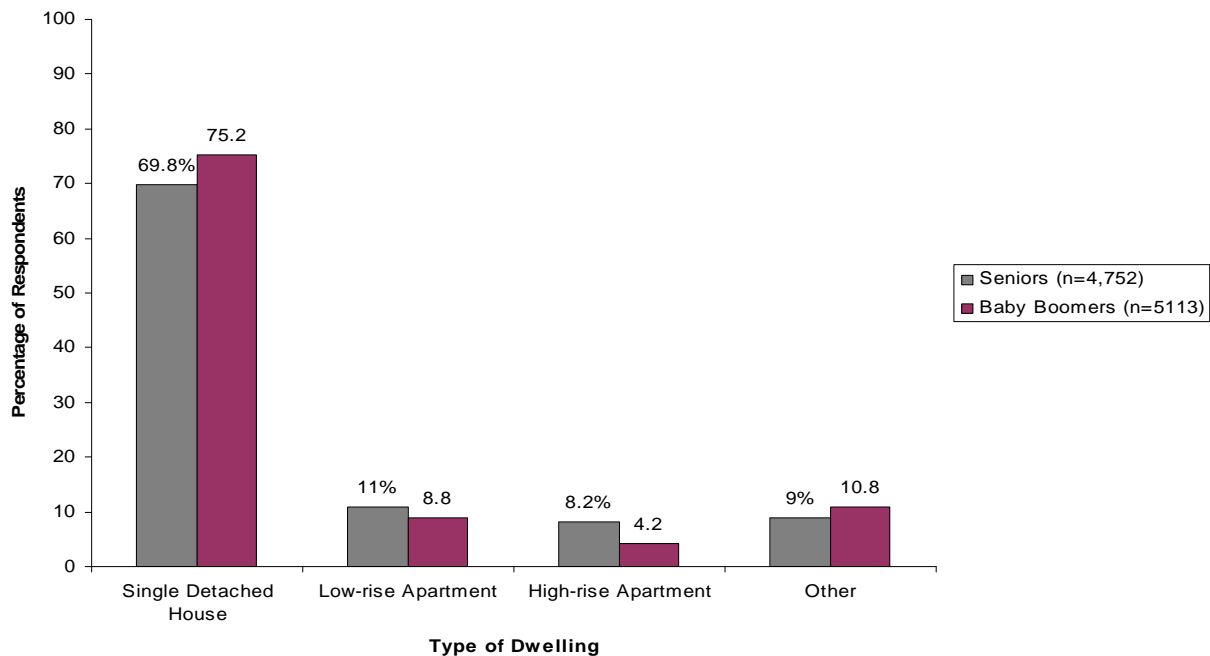


Source: GSS Cycle 14, 2000

Most seniors live in a single-detached house, either with spouse or partner or alone

The majority of the senior population (63%) is married, and continues to live with their spouse. Senior females are far more likely to live alone than senior males, especially with increasing age (Figures 6, 7, and 8). As shown in Figure 5, data from the GSS 14 suggest that the majority of both seniors and Baby Boomers live in a single detached house, usually owned by a member of the respondent’s household. Most respondents had lived in this dwelling for five years or more.

Figure 5: Dwelling Type



Source: GSS Cycle 14, 2000

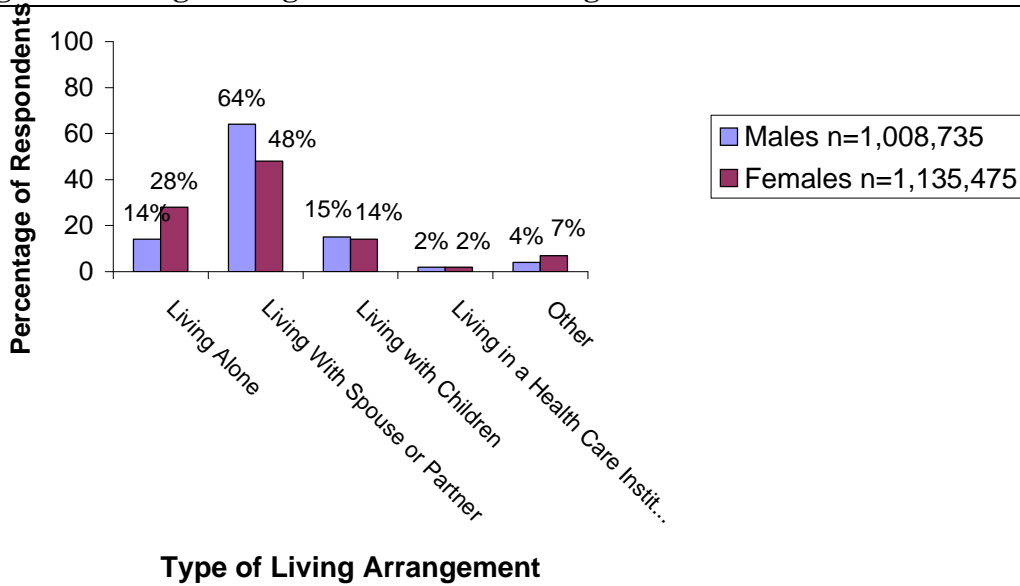
There are generally five categories of living arrangements into which senior citizens are grouped: living alone, living with a spouse or partner, living with children, living in a health care institution, or having some other living arrangement (for example living with another relative, other than child).

Figure 6, Figure 7, and Figure 8 illustrate the living arrangements for gender by different age categories within the senior citizen cohort. We also note the significant decrease in actual numbers of seniors from age groups 65-74 to age 85 and over, with the total number of seniors living in some form of institution increasing with the older segments in the senior cohort, as opposed to “aging at home”.

The likelihood of females living alone increases significantly with age, rising from one in four (28%) to almost one in two (43%) from earlier retirement years (65-74) to later retirement years (74+). A minority of males (15%) and females (15%) live with their children in earlier retirement years, and as both males (10%) and females (11%) age

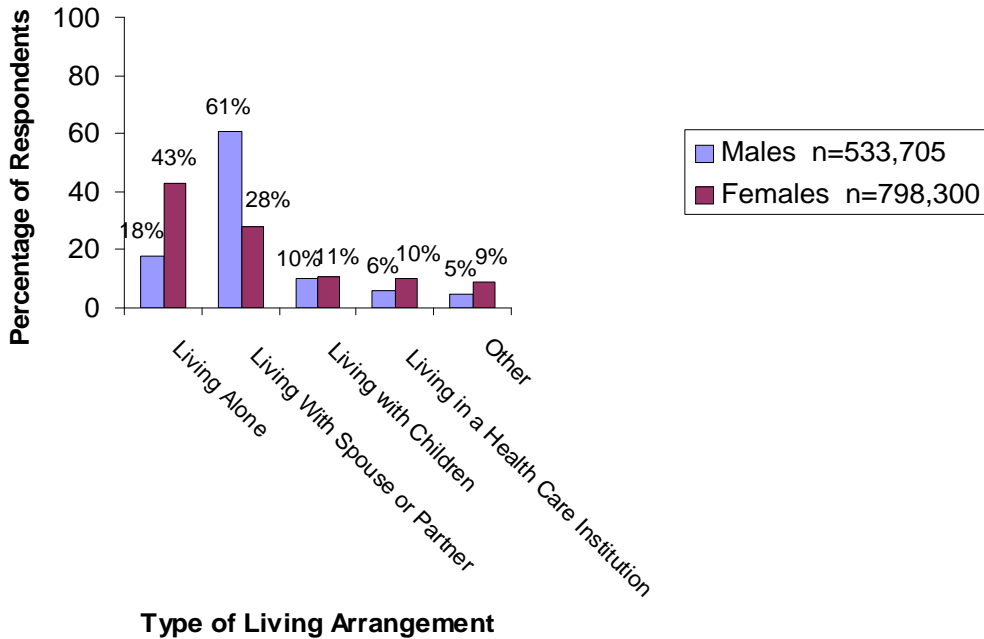
(75+), there is a decrease in the likelihood of this type of living arrangement. A very small minority of seniors live in a health care institution, but there is some increase for both males (6%) and females (10%) in the latter senior years (75+).

Figure 6: Living Arrangements for Seniors Aged 65-74



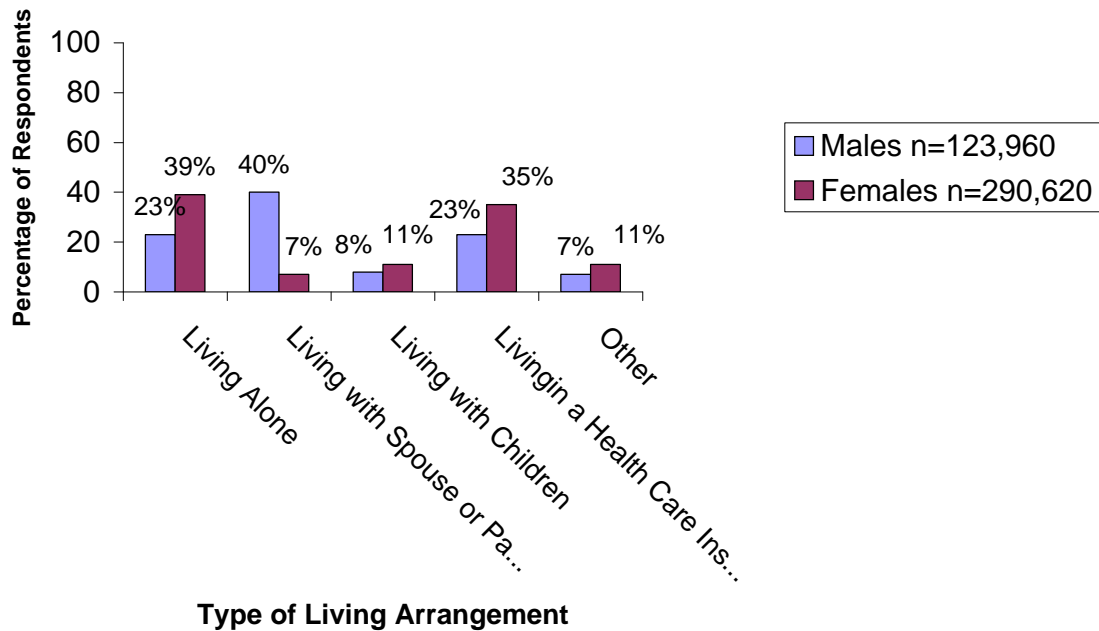
Source: Statistics Canada 89-582-XIE 2001

Figure 7: Living Arrangements for Seniors Aged 75-84



Source: Statistics Canada 89-582-XIE 2001

Figure 8: Living Arrangements for Seniors Aged 85+



Source: Statistics Canada 89-582-XIE, 2001

Demographically, females outlive males, which accounts for the significant increase of females living on their own in the post 75 years cohort. In almost one in four senior couples, males tend to be about 10 years older than females, whereas the remainder tend to be fairly close in age. Table 1 illustrates the percentage of respondents whose spouses are categorized by age group. By age 85 and over, we see a dramatic decrease in females living with a spouse or partner, but this is not the case for males. A plurality of females in this age group either live alone (39%) or live in a formal institution (35%).

Table 1: Respondents' age and spousal age, GSS Cycle 14 2000

Female Respondent Age	Respondent's Spouse's Age					
	25-34	35-44	45-54	55-64	65-74	75+
55-64 (n=1335)	.1%	.6%	3%	46%	19%	1%
65-74 (n=1108)	0	0	0	3%	40%	12%
75+ (n=662)	0	0	0	.1%	3%	27%
Male Respondent Age	Respondent's Spouse's Age					
	24-34	35-44	45-54	55-64	65-74	75+
55-64 (n=1738)	.4	4%	30%	46%	3%	0
65-74 (n=1628)	.1%	.1%	3%	27%	44%	2.5%
75+ (n=1354)	0	.2%	.4%	2%	27%	38%

The majority of senior citizens have modest incomes

Statistics Canada has several indicators of income for Canadians. Among these, the median income for Canadian seniors with a presence of income, is \$17,984. For males the median income is \$21,952, while for females it is \$14,859. For Baby Boomers (Census data on age group 45-64), the median income for both genders is \$29,521. The median for males is \$38,044 and for females is much lower at \$21,357.

The “median” statistic of central tendency is being used here rather than the “mean” or average. When using the average, the value for each case is added together and then divided by the number of cases. As the very high and very low values will tend to skew the statistics, we do not believe this is the best representation of income. The median statistic is the middle value of all cases. The values of the cases are organized in either ascending or descending order. The exact middle of these is taken to eliminate any skew from very high or very low cases. Table 2 illustrates Statistics Canada’s cut-offs for before-tax low income. These figures are based on community size and family size, and provide context to the incomes for each age cohort informing this research project.

Family Size	Community Size				
	500,000+	100,000-499,999	30,000-99,999	Less than 30,000	Rural Areas
1	\$19,261	\$16,524	\$16,407	\$15,267	\$13,311
2	\$24,077	\$20,651	\$20,508	\$19,083	\$16,639
3	\$29,944	\$25,684	\$25,505	\$23,732	\$20,694
4	\$36,247	\$31,090	\$30,875	\$28,729	\$25,050

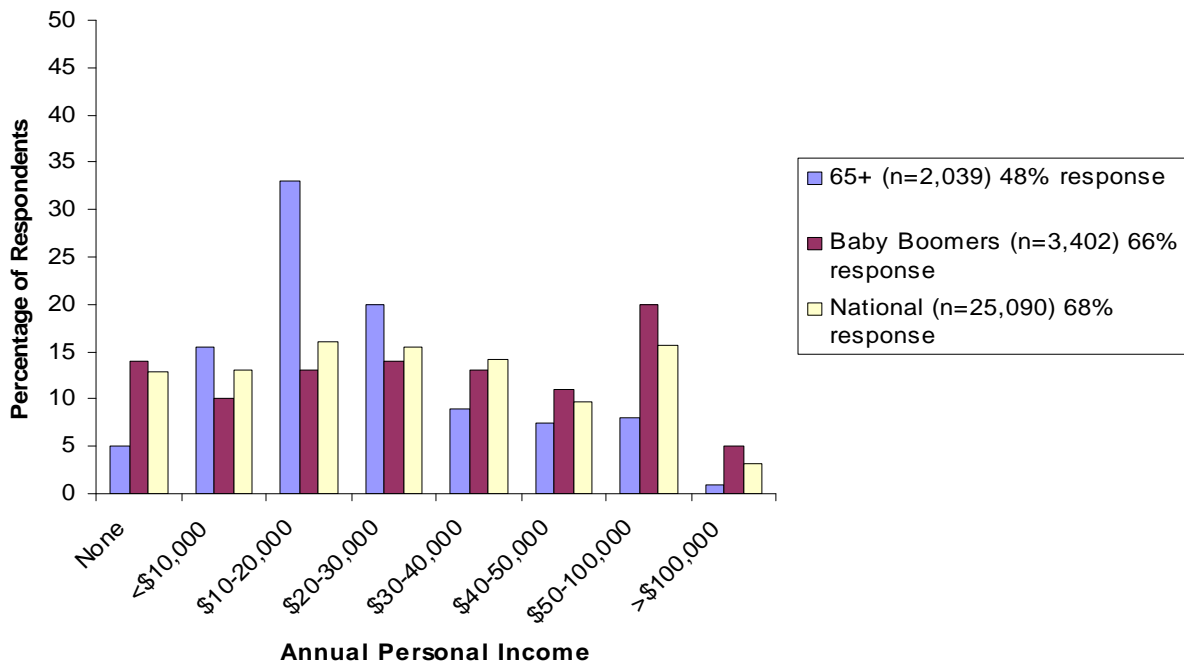
Statistics Canada also reports income by economic family type, which represents income from all sources, including government transfers and representing amounts before the deduction of federal and provincial income taxes. The economic family is defined as a group of persons who share a common dwelling and who are related by blood, marriage (as well as common law union) or adoption and is two or more people. Elderly economic families are those whose major income earner is 65 years and older. In 2001 the average total income for the elderly economic family was \$46,410.

The majority of senior respondents in the GSS 14 2000 were retired, with the main source of income during the past 12 months being a retirement pension, benefits (Canada/Quebec), followed by basic old age security. Forty-eight percent of respondents answered the question on annual income. Figure 11 illustrates that a third (33%) of respondents had an annual income between \$10,000 and \$20,000. Half (50.5%) of senior respondents had an income of less than \$20,000 per year, with about one in five reporting less than \$10,000 in income and five per cent reporting no income.

The main source of income for the majority of Baby Boomer respondents (56.3%) in the GSS 2000 was employment. Figure 9 illustrates comparatively with both seniors and a national representation, the proportion of Baby Boomers in each income category. Sixty-

six percent of Baby Boomer respondents aged 50-64 answered the question on annual personal income. Over a third (36.7%) had an annual income below \$20,000. About the same proportion of Baby Boomers had annual incomes between \$20,000 and \$50,000 (37.4%). Almost a quarter of Baby Boomers had an annual income of between \$50,000 and \$100,000 (21%). Baby Boomers tend to be in higher income brackets than the national average.

Figure 9: Annual Personal Income of Respondents



Source: GSS Cycle 14, 2000

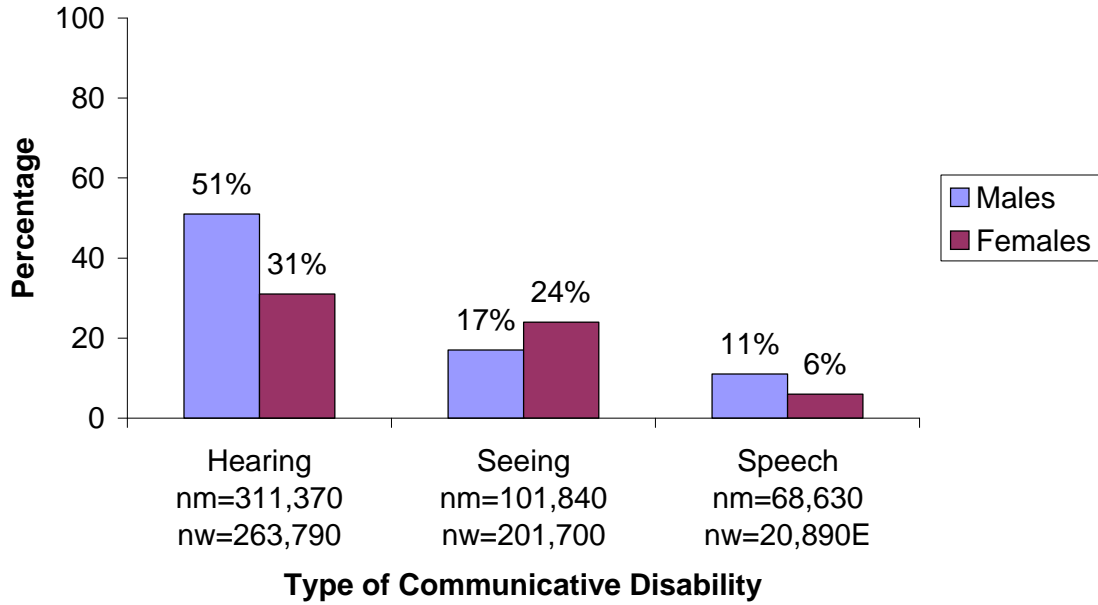
Seniors with disabilities make up a large proportion of the senior population

Data collected as part of the Participation and Activity Limitation Survey (PALS), 2000, indicates that seniors with disabilities make up 40.5% of the senior population in Canada. It has been suggested by experts that this number is not an accurate representation because seniors tend to underreport disability². Tabulations of PALS data further suggest that disabled persons aged 55-64 make up 22% of that respective population.

The research team categorized the disabilities as physical disabilities, communicative disabilities, and cognitive/mental disabilities. Figures 10, 11, and 12 show the results of these categories. Physical disabilities include agility, mobility, and pain. Communicative disabilities include hearing, seeing, and speech. Finally, cognitive/mental disabilities include developmental, learning, memory, and psychological. Slightly more females report having a physical disability, while slightly more males report hearing, speech and memory disabilities. Physical disabilities are much higher for this age group than any other.

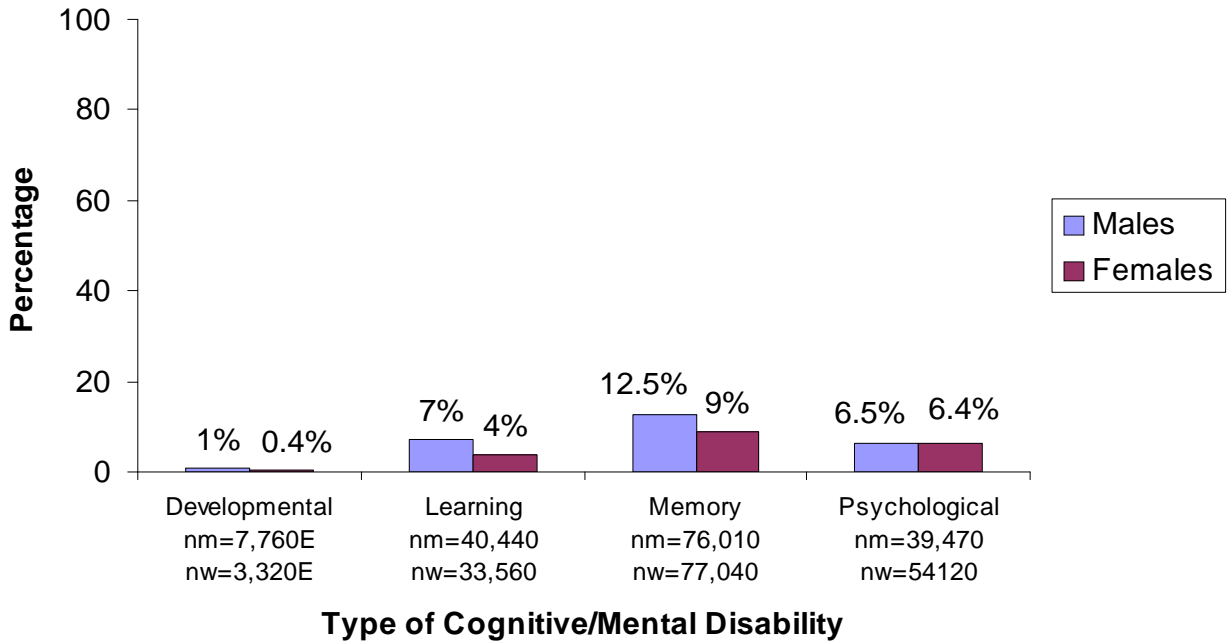
² Consultation with federal government expert on disabilities in Canada, 2004

Figure 10: Communicative Disabilities for Disabled Seniors



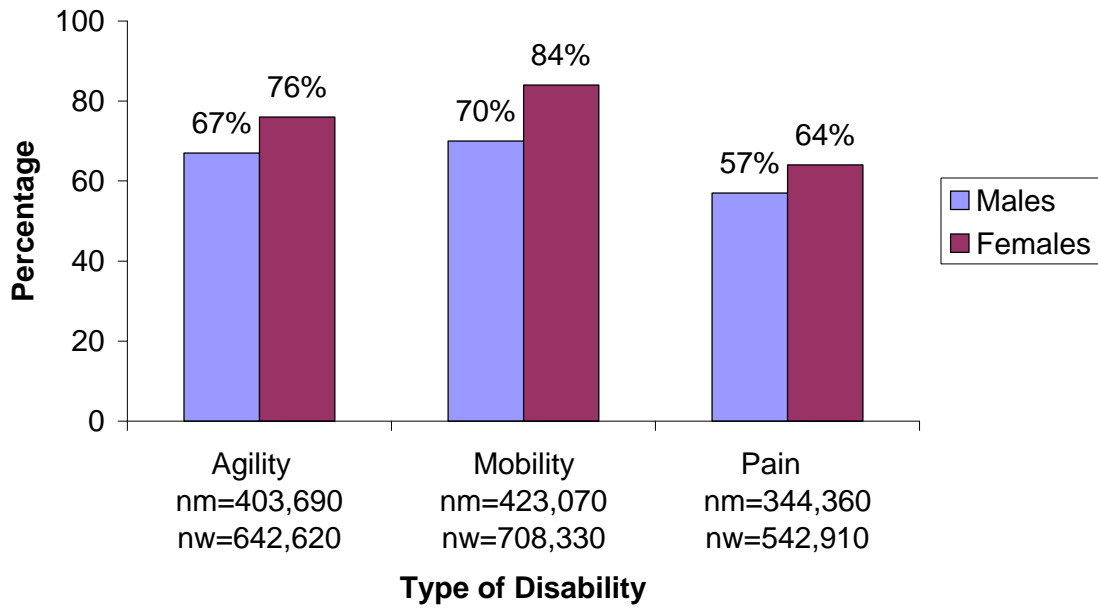
Source: PALS 2000

Figure 11: Cognitive/Mental Disabilities for Disabled Seniors



Source: PALS 2000

Figure 12: Physical Disabilities for Disabled Seniors, PALS 2000



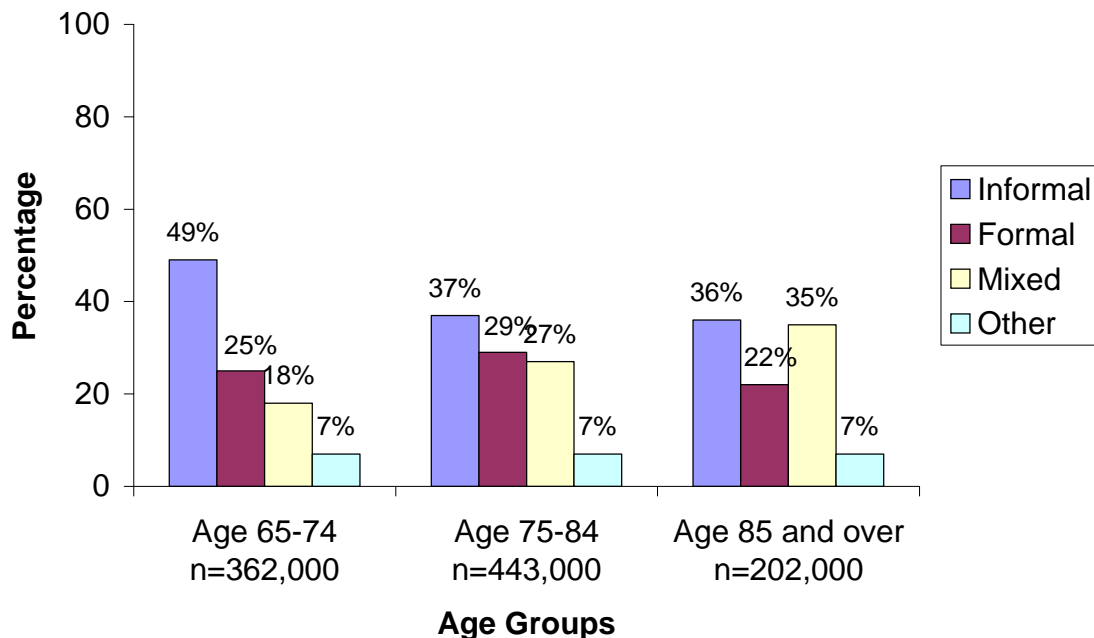
Source: PALS 2000

Care for seniors with long-term health problems tends to be informal

Four different types of care arrangements include formal, informal, mixed and other. Formal care is care given by governmental and non-governmental organizations and paid employees. Informal care is care given by family and friends. Mixed care is care given by a mix of formal and informal sources. “Other” is some other type of care arrangement.

Figure 13 indicates that the majority of care received by all three groups is informal care, while a combination of mixed and formal care increases with age. Formal care is relatively static across the three age groups. “Other” forms of care are minimal, and with such low sample sizes for the age group 85 and over, reliability is jeopardized.

Figure 13: Prevalence of Care Received for Long-Term Health Problems,



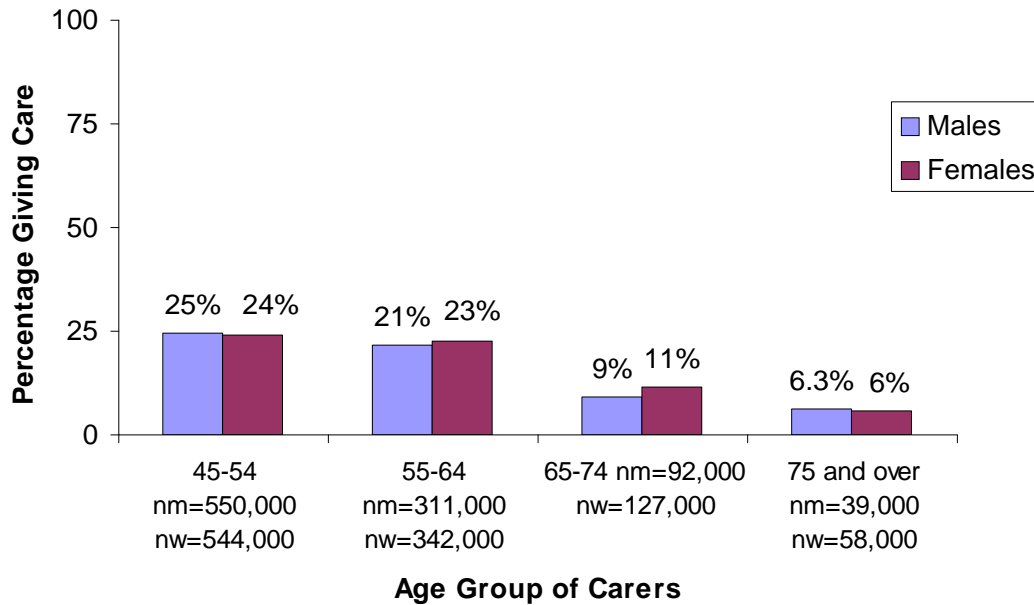
Source: GSS Cycle 16 2002

It is interesting to note that of a Canadian population of persons aged 45 years and over numbering 11,144,000, 18.5% are informal caregivers. Figure 14 illustrates the prevalence of informal caregivers giving care to seniors. It is also interesting to note that traditionally “caregiver” stereotypically refers to females, but we see that results from the GSS 16 suggest that the proportions are relatively equal between the sexes of caregivers.

Caregivers aged 45 years and over are already quite likely to be using assistive devices in their work to care for aging seniors. Thus, it is important to include them in any future assessment of the needs of seniors related to aging in place, as they may be the major

users of ICT for this purpose, both presently and in the future. The majority of caregivers fall into the Baby Boomer cohort.

Figure 14: Prevalence of Caregivers Aged 45 Years and Over



Source: GSS Cycle 16 2002

Television is the most important information and communication technology

Results from the GSS14 indicate that telephone, television, home entertainment and newspapers are the most important informative devices for seniors, with Internet and magazines considered about half as important. Magazines were the least important to seniors. More recent research results indicate (Table 3) that although cable television remains one of the most important ICT items in the household, there is a growing importance being placed on other types of ICT, especially for Baby Boomers (EKOS, 2003).

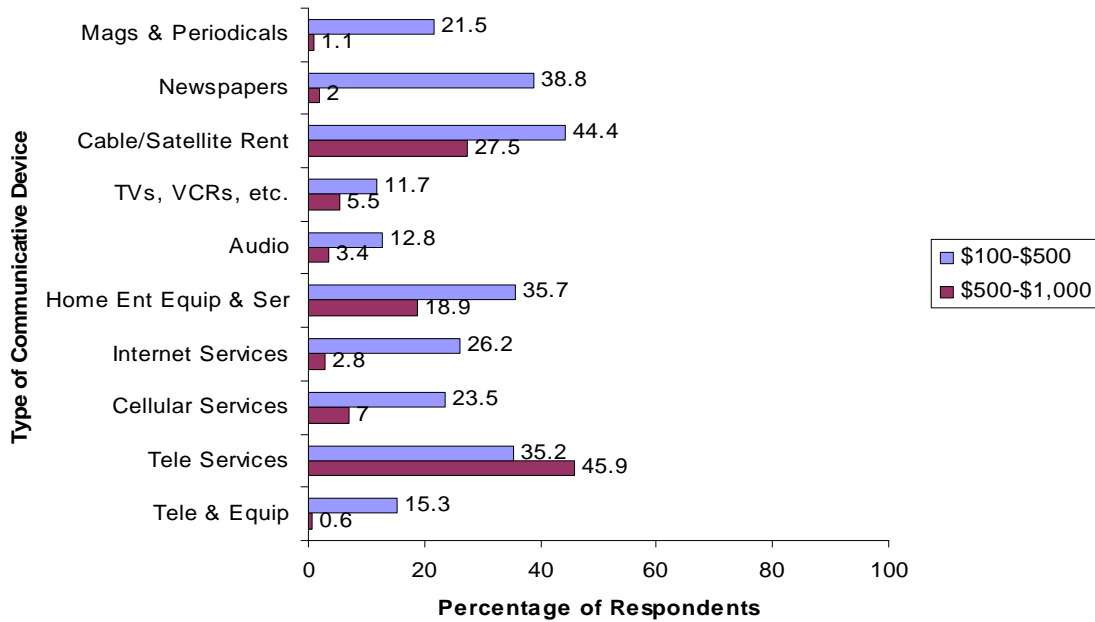
Figure 15 illustrates that seniors spent far more annually in 2000 on cablevision/satellite rental and home entertainment equipment and service than any other communicative device, with the exception of expenditures for telephone services. Baby Boomers also considered television to be the most important information device in the home (69.1%), followed by newspapers (55.8%), radio, Internet, and magazines. Figure 16 illustrates that Baby Boomers spent more annually in 2000 on cable and satellite and telephone service than other ICT items. As results from more recent EKOS research suggest that the

importance of other ICT items has been increasing, annual expenditure trends may also be comparable, but as yet we have no data to support this.

Table 3: Importance of ICT in 2003					
Baby Boomers N=901					
	Not necessary	Rating 2 to 3	Optional	Rating 5-6	Essential
Cable TV	14%	7%	16%	38%	23%
Cell or PCS phone service	14%	10%	24%	31%	19%
Personal Computer	8%	7%	22%	34%	28%
Internet	10%	8%	18%	34%	26%
Email	11%	8%	18%	34%	26%
Seniors N=334					
	Not Necessary	Rating 2 to 3	Optional	Rating 5-6	Essential
Cable TV	15%	6%	11%	35%	29%
Cell or PCS phone service	24%	8%	28%	25%	12%
Personal Computer	21%	9%	20%	33%	14%
Internet	24%	10%	19%	30%	13%
Email	23%	8%	18%	32%	16%

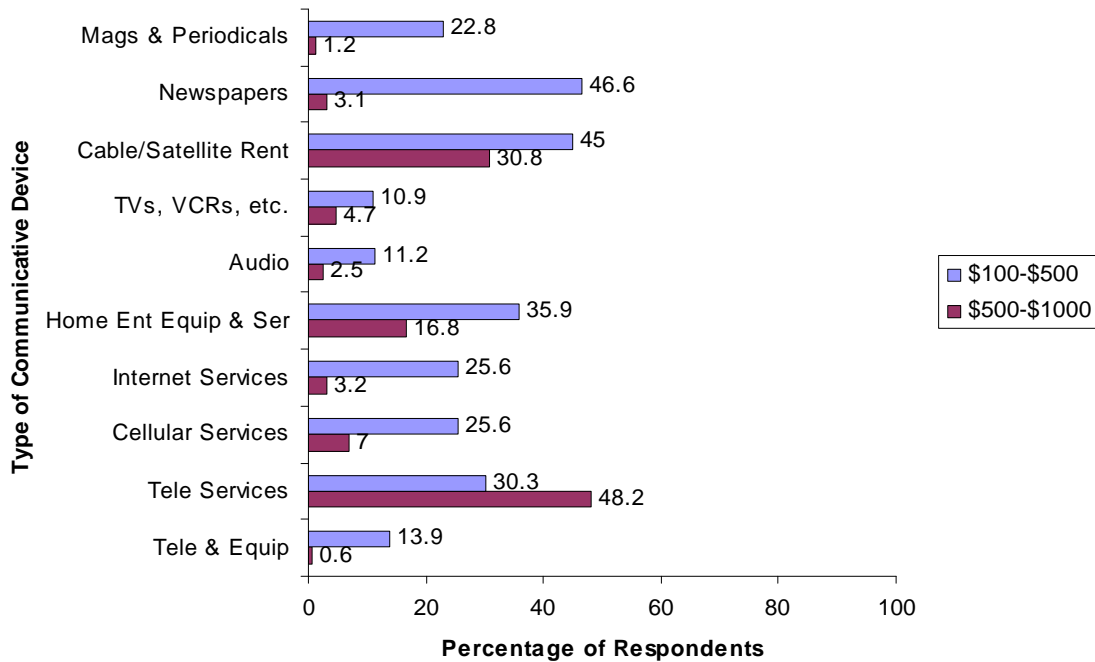
Source: EKOS 2003

Figure 15: Seniors' Annual Expenditure on Communicative Devices in 2000



Source: SHS 2000 N= 3,106

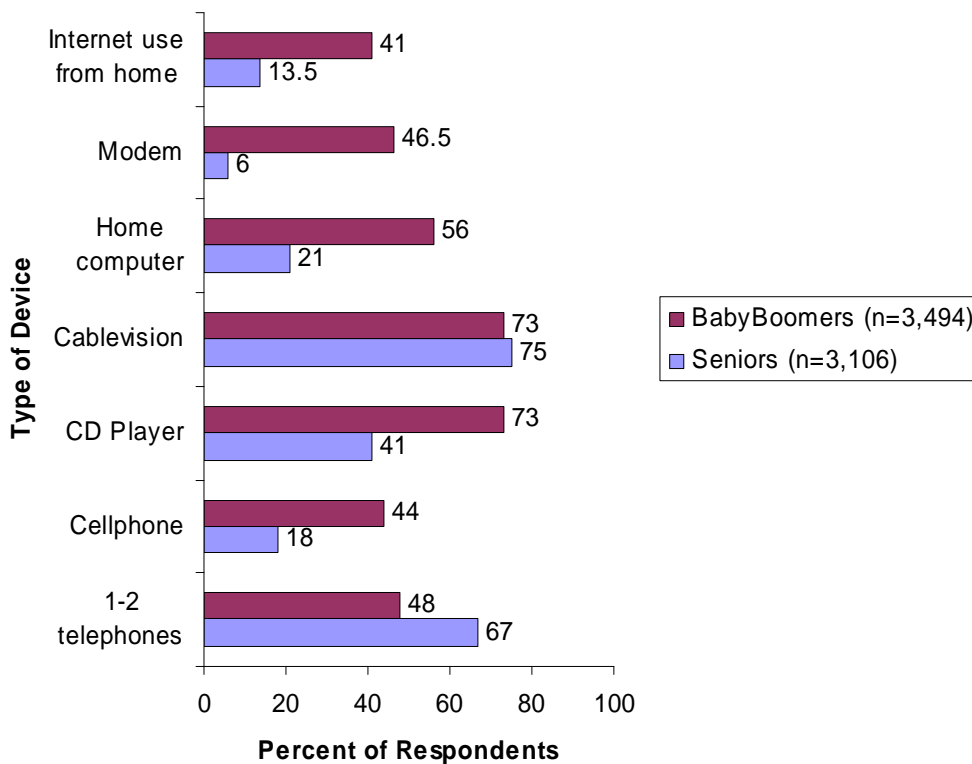
Figure 16: Baby Boomers' Annual Expenditure on Communicative Devices in 2000



Source: SHS 2000 N=3,494

Figure 17 illustrates the types of communicative devices seniors and Baby Boomers are likely to have. The majority of both seniors (75%) and Baby Boomers (73%) have cablevision. Following that is having one to two telephones for seniors while Baby Boomers are more likely to have 2 or 3 telephones at home. Three times as many Baby Boomers (41%) as seniors (13.5%) have Internet use from home and almost 8 times as many Baby Boomers have a modem. With the exception of cablevision and telephones, the number of Baby Boomers who have communicative devices at home far exceeds the number of seniors.

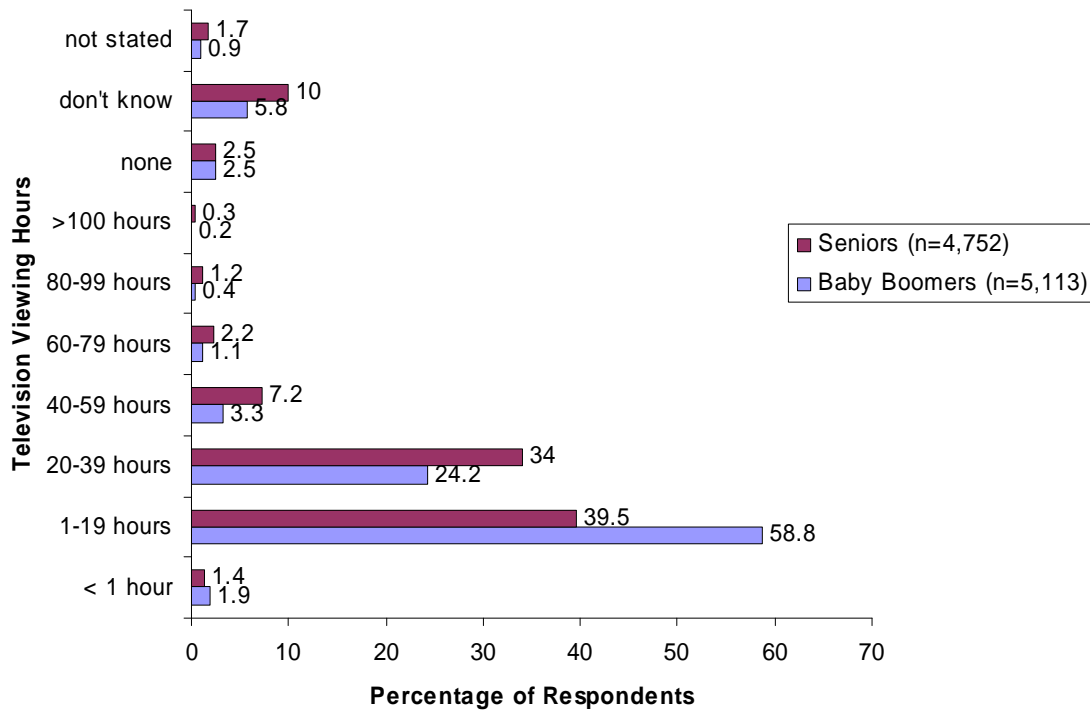
Figure 17: Types of Communicative Devices Owned by Seniors and Baby Boomers in 2000



Source: SHS 2000

Figure 18 shows that the majority of Baby Boomers watch less television than seniors, with 60% watching less than 20 hours of television per week. Almost half of seniors watch more than 20 hours of television per week, with just over a third (39.5%) watching up to 20 hours per week. Only slightly more seniors spend more time watching television than Baby Boomers (11% watching 40 or more hours of television per week, and 5% of Baby Boomers watching 40 or more hours per week).

Figure 18: Amount of Television Viewing by Seniors and Baby Boomers in 2000

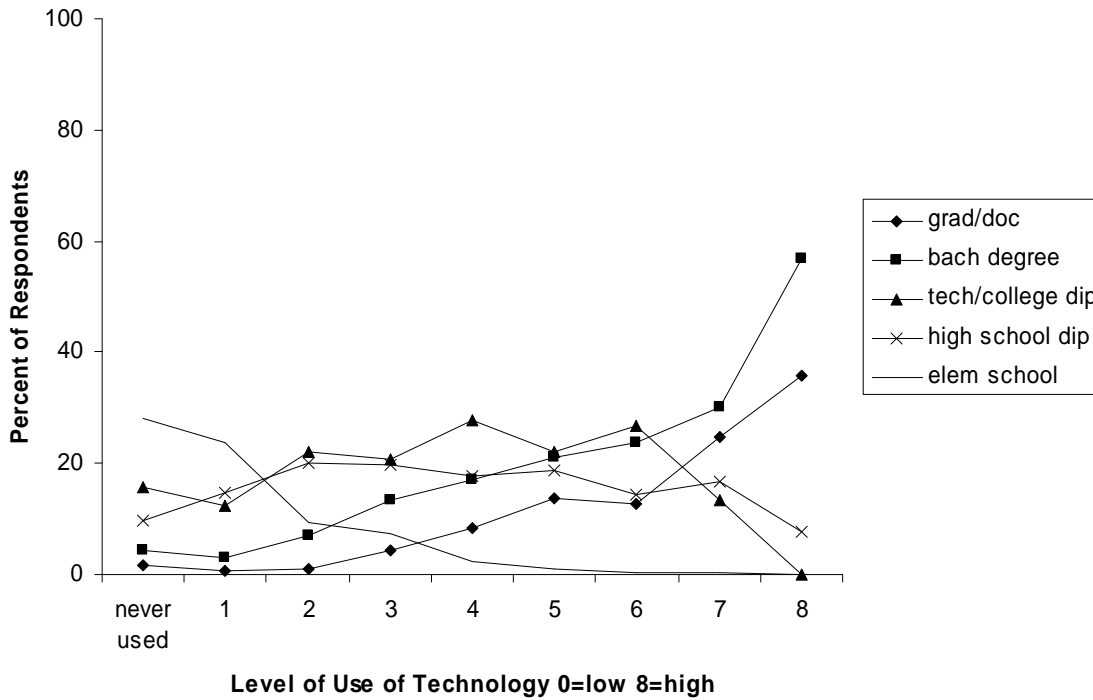


Source: GSS Cycle 14, 2000

Seniors and Baby Boomers have different levels of ICT use

Seniors had lower levels of use of technology than other age groups. Even those with higher levels of education tended to rank themselves in the lower-to-middle spectrum of the use of technology scale. Figure 19a and 19b illustrate self-rankings for both seniors and Baby Boomers on the use of technology. Results of cross-tabulations for Baby Boomers were much different from those of seniors, with respondents with higher levels of education being ranked at the highest end of the use of technology scale (see Figure 19a and Figure 19b).

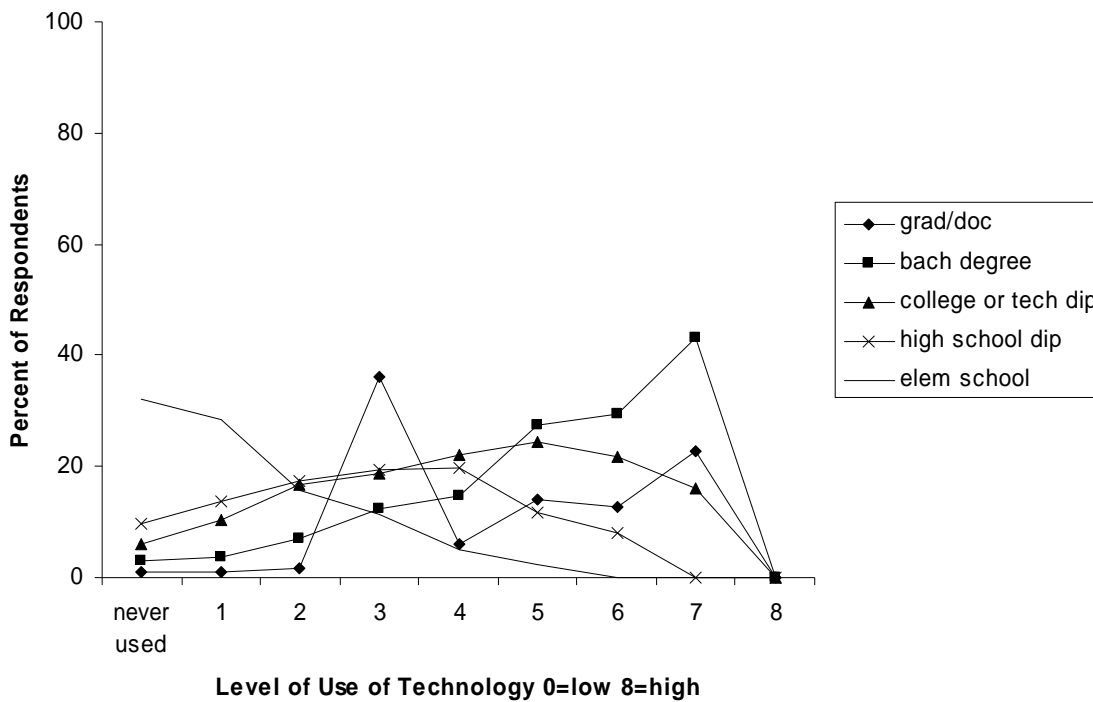
Figure 19a: Level of Use of Technology For Baby Boomers in 2000



Source: GSS Cycle 14, 2000

n=5,113

Figure 19b: Level of Use of Technology For Seniors in 2000

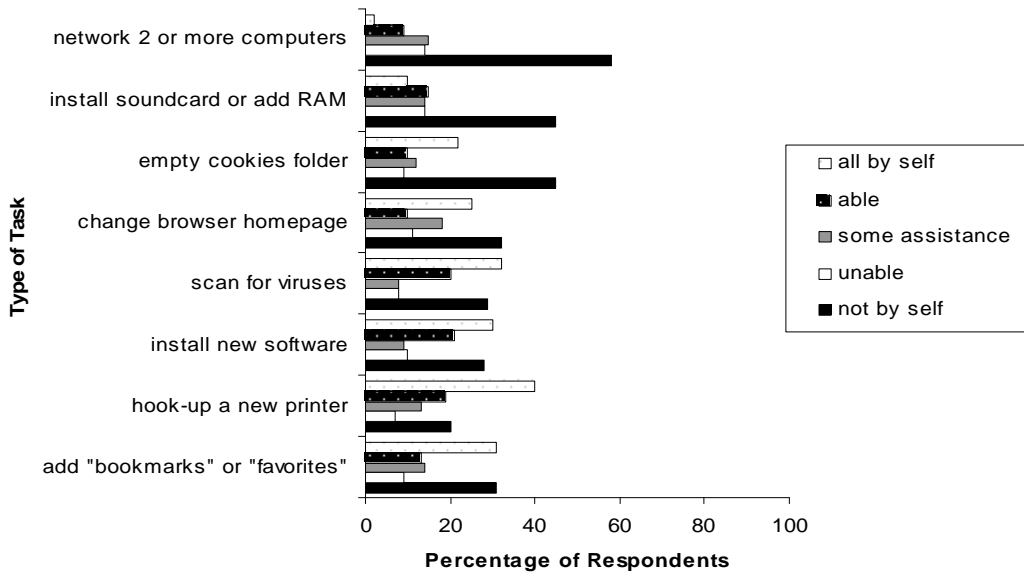


Source: GSS Cycle 14, 2000

n=4,752

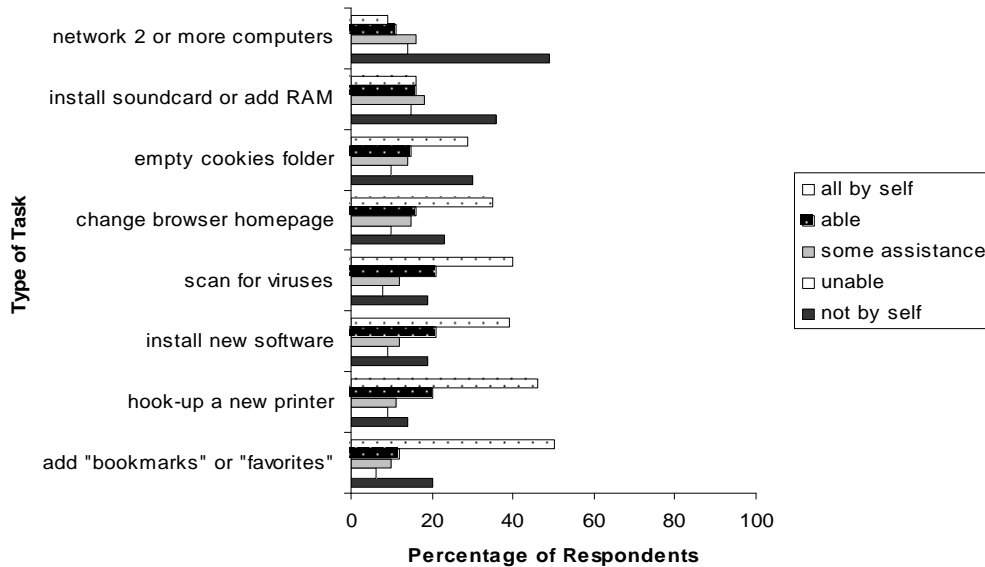
In more recent research (EKOS 2003), Internet users were asked to rate their ability to do certain computer related tasks, including changing the browser homepage on their Internet browser and emptying “cookies”, figures 20a and 20b illustrate the different levels of abilities between seniors and Baby Boomers to perform these tasks, where Baby Boomers are much more technically adept in these activities.

Figure 20a: Ability Ranking of Senior Internet Users in 2003



Source: EKOS 2004

Figure 20b: Ability Ranking of Baby Boomer Internet Users in 2003



Source: EKOS 2004

The greatest barriers to computer use are cost and lack of training

Of the total population of seniors responding to the GSS 14, numbering 4,752, 19% had a computer at home. 13% had used a computer in the past 12 months, and of those who had not used a computer in the past 12 months, only 7% had ever used a computer.

Of the 5,113 Baby Boomers responding to the GSS 2000, 54% had a computer at home. 52% had used a computer in the past 12 months, and of those who had not, 8.5% had ever used a computer.

Of those seniors who had ever used a computer, the majority of respondents rated themselves as poor, fair, and good when asked their perception of level of ability. Of the 60% of Baby Boomers who had ever used a computer, the majority of respondents rated themselves as fair and good on level of ability.

11% of seniors were interested in using a computer, and over half of those expected to use a computer in the next 12 months. The majority of these seniors indicated that this would most likely be at home. The greatest barrier to computer use for seniors was cost, followed by lack of training.

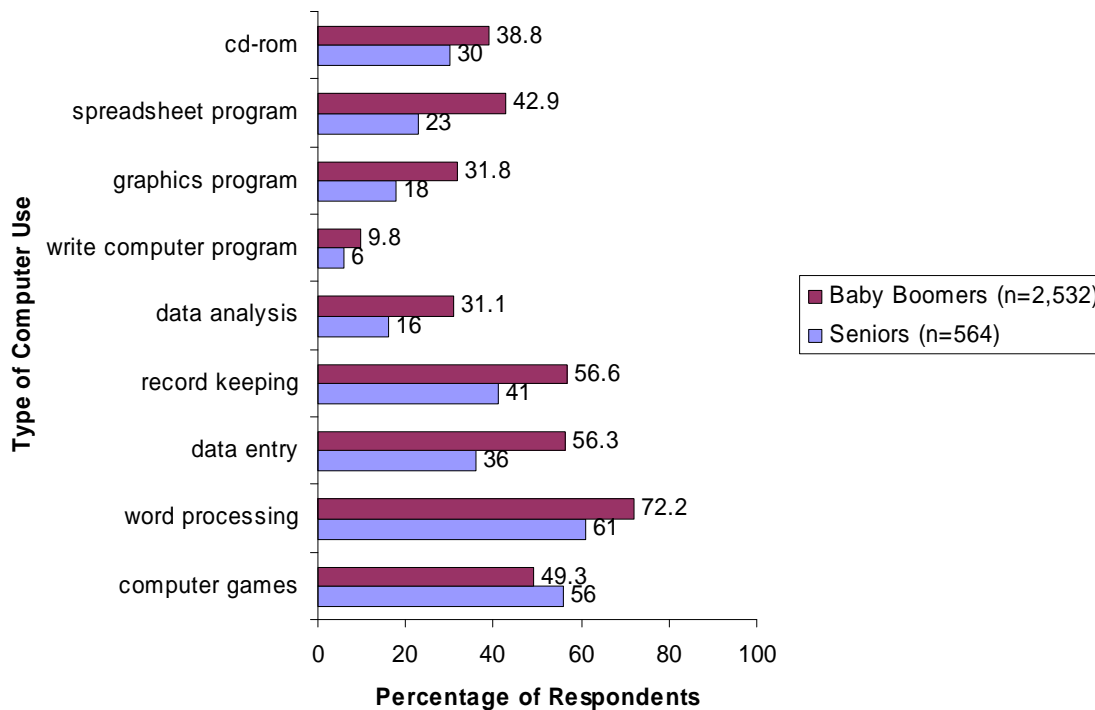
Forty-five percent of Baby Boomer respondents were asked of their interest in using a computer, of which 23.7% replied that they were indeed interested. Ten percent of respondents were asked about the barriers to use; 35% indicated cost, 23% indicated they didn't have enough time, and 17% indicated lack of training.

Figure 21 illustrates that seniors tend to use their computers for word processing, games and record keeping. From information gathered from consultations for this project, there is likelihood that reporting of computer usage for word processing, data entry, and record keeping may be the result of volunteer work³. Figure 21 also demonstrates the computer uses of the Baby Boom cohort. The majority of Baby Boomers indicate that they first started using a computer for work needs (58.1%), followed by personal interest (35.5%). The majority had used a computer for 1-5 years (36%), followed by those who had been using a computer for up to 10 years (29%). Almost 100% of Baby Boomer users had had training, of which 63% had had formal training and 21% semi-formal.

The majority of senior computer users had been using a computer between one and five years. Interestingly, of those seniors who had used a computer in the last 12 months, 98% had received computer training, the majority of which had been formal training.

³ Consultation with NGO representative, 2004

Figure 21: Types of Computer Use in 2000



Source: GSS Cycle 14, 2000

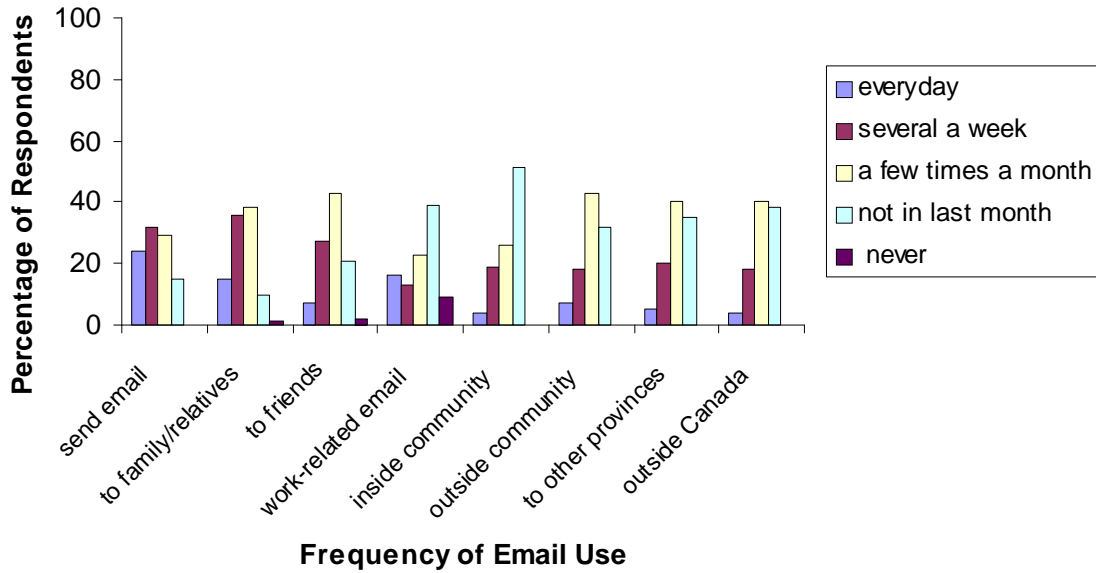
Seniors are using the Internet to “stay in touch” with the world

Of the total population of senior respondents, 12% were connected to the Internet. Over three-quarters of those were connected through a telephone line, followed by almost 13% connected by cable. Of those who had not used the Internet in the past 12 months, only one percent had ever used the Internet. Eleven percent of respondents had used the Internet in the past 12 months and the majority of those had been using it for one to three years. 91% of respondents indicated that the main reason for first using the Internet was for personal use.

More recent EKOS (2004) research suggests that 70% of persons aged 45-64 had used the Internet in the previous 3 months to the interview, but that one in 5 had never used the Internet. This research also reports that 35% of seniors aged 65 years and over had used the Internet in the previous 3 months, but that a majority 60% had never used it.

Forty-two percent of senior Internet-users had used email in the past 12 months. Figure 22a and Figure 22b illustrate the amount and nature of email use for seniors and Baby Boomers. General email-use is quite static across frequency of use, with similar proportions of emails sent everyday, several times a week, and a few times a month. Of this, several emails were being sent to family and friends. Interestingly, emails were also being sent regularly outside of the community, province, and country. Baby Boomers are more likely than seniors to email everyday. We also note that daily email use tends to be work-related.

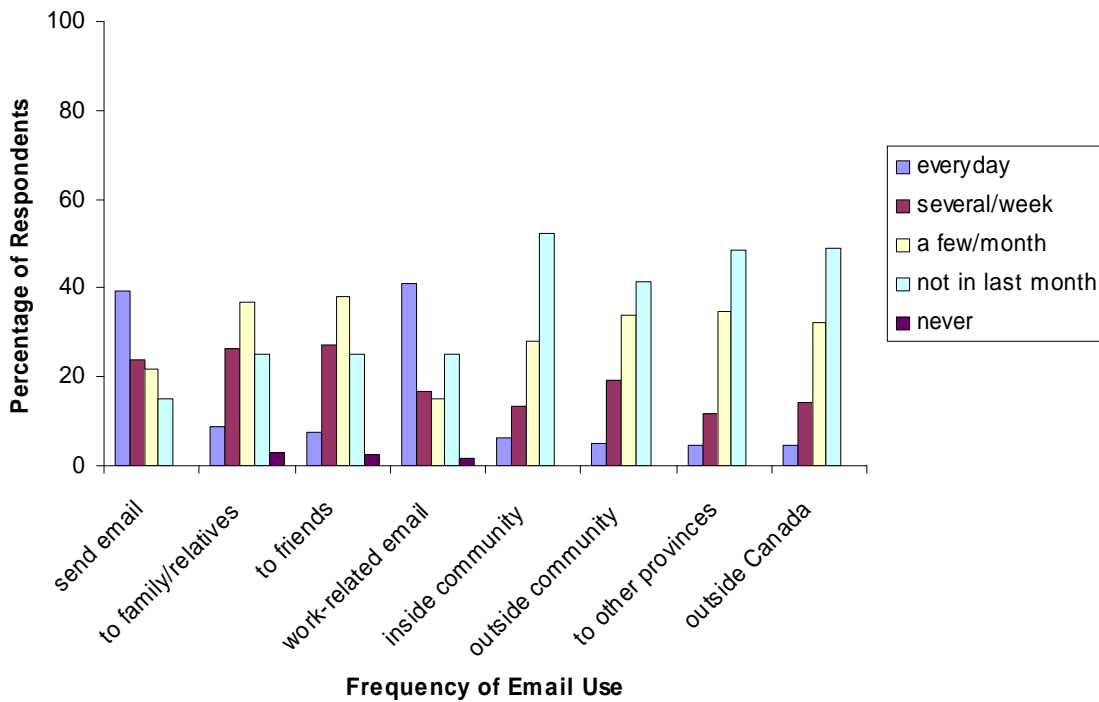
Figure 22a: Frequency of Email Use by Seniors in 2000



Source: GSS Cycle 14, 2000

N=270

Figure 22b: Frequency of Email Use by Baby Boomers in 2000



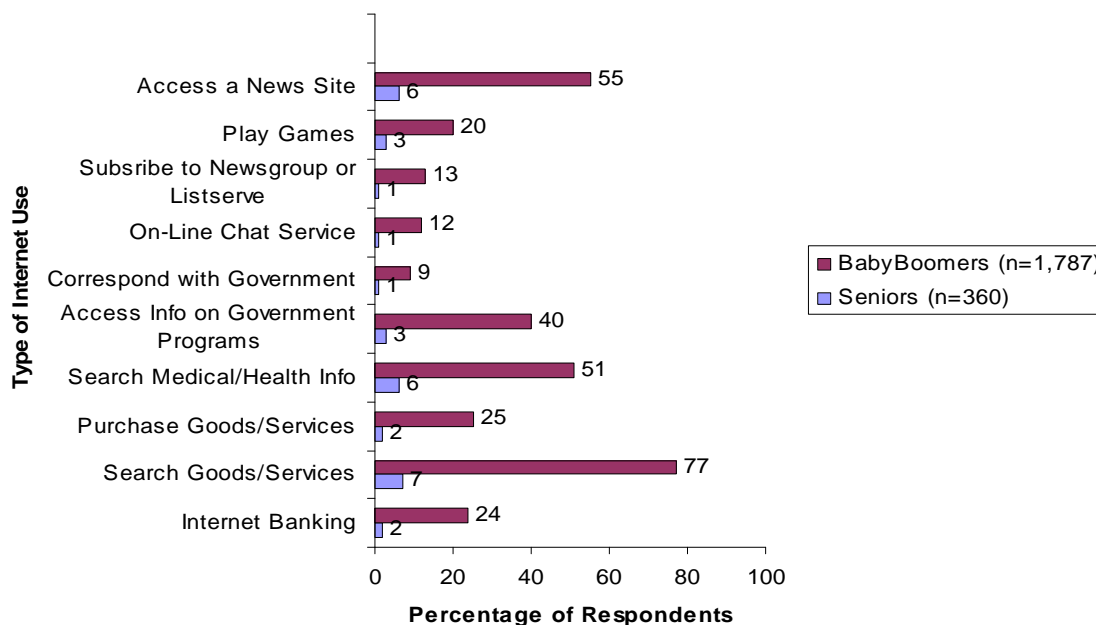
Source: GSS Cycle 14, 2000

N=1,417

Seniors and Baby Boomers who had used the Internet in the past 12 months (11% of senior respondents and 37.8% of Baby Boomer respondents) were asked questions about the nature and frequency of that use. Figure 23 illustrates the types of Internet use by seniors and Baby Boomers. The majority of senior respondents had used the Internet to search for goods and services (62%), medical and health information (51%), and to access a news site (56%). The type of medical and healthcare information that seniors search for using the Internet is predominately for specific diseases.

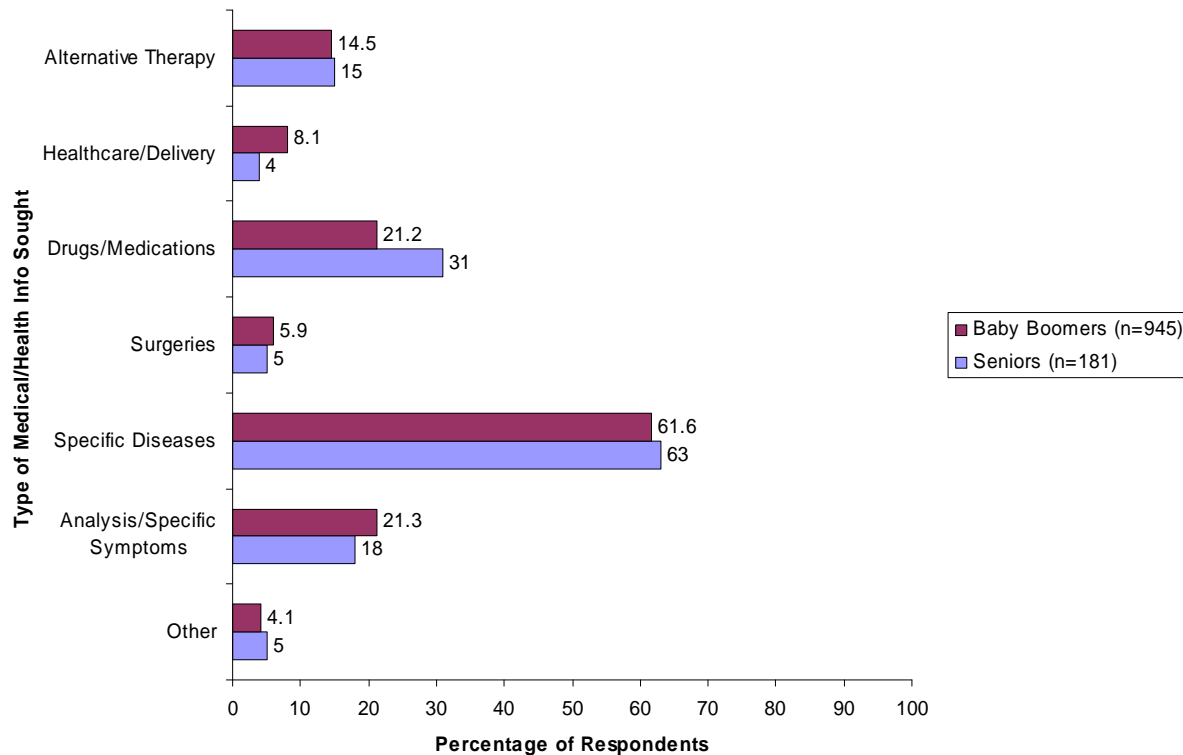
Figure 24 illustrates the different types of medical and healthcare information sought by seniors on-line. Far more Baby Boomers were on-line and the majority of those users were searching for goods and services (76.8%), medical and health information (51%), accessing a news site (55.4%), and accessing information on government programs (39.6%). A quarter of Baby Boomer respondents were using the Internet to do their banking and to purchase goods and services.

Figure 23: Types of Internet Use in 2000



Source: GSS Cycle 14, 2000

Figure 24: Type of Medical/Health Information Sought in 2000



Source: GSS Cycle 14, 2000

Increased Internet use expected of both seniors and Baby Boomers in future.

Eight percent of the “non-user” senior respondents in the GSS Cycle 14 were interested in using the Internet, and over three-quarters expected to use the Internet at home in the next 12 months. Thirteen percent of all Baby Boomer respondents were interested in using the Internet, and 74% of these indicated that this would most likely be in the home. Senior respondents indicated that the greatest barriers to using the Internet were cost and access. Baby Boomer respondents indicated the greatest barriers were access, lack of time, cost, and lack of training. More recent results from EKOS research (2004) suggests that cost is no longer the primary reason for not using the Internet, but rather, reasons include lack of interest, lack of actual computer, and lack of need.

Summary

Results of analyses using national datasets and available national research results indicate that the majority of seniors in Canada have low incomes as well as low levels of education compared to the Baby Boom cohort. There are many more senior females than males who live alone. Seniors have a range of disabilities, predominately physical types of disabilities. It is evident that seniors try to stay engaged with society, family and

friends by way of television, telephone, newspapers and radios. A minority of seniors in Canada are using the Internet, and for those who do, many are using email. Many seniors are also using the Internet to search for goods and services, medical and healthcare information, and to access news sites. Greatest barriers to the use of computers and Internet are cost, access, lack of training, and lack of interest.

References

Abowd, G. D., Atkeson, C., Bobick, A., Essa, I., MacIntyre, B., Mynatt, E., et al. (2000). Living laboratories: The future computing environments group at the Georgia Institute of Technology. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems* (pp. 215-216): ACM Press.

Agree, E. M., & Freedman, V. A. (2003). A Comparison of Assistive Technology and Personal Care in Alleviating Disability and Unmet Need. *The Gerontologist*, 43(3), 335-344.

Allen, D. (2001). *High Speed IP Video-Conferencing: Revolutionizing Services to Deaf, Deafened and Hard of Hearing People*. Paper presented at the International Conference on Technology and Aging, Toronto.

Arnaert, A., & Delesie, L. (2001). Telenursing for the elderly: The case for care via video-telephony. *Journal of Telemedicine and Telecare*, 7, 311-316.

Asada, H. H., Shaltis, P., Reisner, A., Rhee, S., & Hutchinson, R. C. (2003). Mobile Monitoring with Wearable Photoplethysmographic Biosensors. *IEEE Engineering in Medicine and Biology Magazine*, 22(3), 28-40.

Beigl, M. (2000). MemoClip: A Location based Remembrance Appliance. *Personal Technologies*, 4(4), 230-234.

Beigl, M., Gellersen, H.-W., & Schmidt, A. (2001). Mediacups: experience with design and use of computer-augmented everyday artefacts. *Computer Networks: The International Journal of Computer and Telecommunications Networking*, 35(4), 401-409.

Berliss-Vincent, J. (2001). *Accommodating the Effects of Aging and Computer Injury For Seniors Who are Long-Time Computer Users*. Paper presented at the International Conference on Technology and Aging, Toronto.

Bleise, N. (1982). Media in the Rocking Chair: Media Uses and Functions Among the Elderly. In G. Gumpert & R. Cathcart (Eds.), *Inter/Media: Interpersonal Communication in a Media World (2nd ed)* (pp. 624-634). New York: Oxford University Press.

Buhler-Wilkerson, K. (2001). *No Place Like Home: A History of Nursing and Home Care in the United States*. Baltimore, MD: The Johns Hopkins University Press.

Chambers, M., & Connor, S. L. (2002). User-friendly technology to help family carers cope. *Journal of Advanced Nursing*, 40(5), 568-577.

Chappell, N. (2001). Sociology of Aging in Canada: Issues for the Millennium. *Canadian Journal on Aging*, 20 suppl. 1, 82-110.

- Chatman, E. A. (1992). *The Information World of Retired Women*. Westport, CT: Greenwood.
- Chittaro, L. (Ed.). (2003). *Human-Computer Interaction with Mobile Devices and Services: 5th International Symposium, Mobile HCI 2003* (Vol. 2795). Udine, Italy: Springer Verlag.
07.
- CMHC. (2003). *Maintaining Seniors' Independence Through Home Adaptations*. Ottawa: Canada Mortgage and Housing.
- Cohen, J. (1994). Out to Lunch: Further Adventures Monitoring Background Activities. In *Proceedings of the Second International Conference on Auditory Display (ICAD'94)*. Santa Fe, NM: Addison-Wesley.
- Cortés, U., Annicchiarico, R., Vázquez-Salceda, J., Urdiales, C., Cañamero, L., López, M., et al. (2003). Assistive technologies for the disabled and for the new generation of senior citizens: the e-Tools architecture. *AI Communications*, 16(3), 193-2
- CRTC. (2002). *Report on Interactive Television Services*. Ottawa: Canadian Radio-television and Telecommunications Commission.
- Cubberly, M., Skrzyszewski, S., & White, F. (1999). *Seniors' Connectivity Strategy*. Ottawa: Report prepared for Industry Canada by ASM Advanced Strategic Management Consultants.
- Czaja, S. J., Eisdorfer, C., & Schulz, R. (2000). Future Directions in Caregiving: Implications for Intervention Research. In R. Schulz (Ed.), *Handbook on Dementia Caregiving: Evidence-Based Interventions for Family Caregivers*. New York: Springer.
- Dalton, D. S., Cruickshanks, K. J., Klein, B. E., Klein, R., Wiley, T. L., & Nondahl, D. M. (2003). The Impact of Hearing Loss on Quality of Life in Older Adults. *The Gerontologist*, 43(5).
- Denton, M. (1997). The linkages between informal and formal care of the elderly. *Canadian Journal on Aging*, 16(1), 30-50.
- Dervin, B. (1983). *An Overview of Sense-Making Research: Concepts, Methods, and Results to Date*. Paper presented at the Annual Meeting of the International Communication Association, Dallas, Texas.
- Dervin, B. (1989). Users as Research Inventions: How Research Categories Perpetuate Inequities. *Journal of Communication*, 39 (3), 216-232.
- Dishman, E. (2004). Inventing Wellness Systems for Aging in Place. *Computer*, 37(5), 34-41.

Dulude, L. (2001). *Usability of Interactive Voice Response Systems in Real-Life Tasks Performed by Old and Young Women*. Paper presented at the International Conference on Technology and Aging, Toronto.

Dyck, J. L., & Smither, J. A. (1994). Age Differences in Computer Anxiety: The Role of Computer Experience, Gender and Education. *Journal of Education Computer Research*, 10, 239-248.

Edwards, C. (2004). Intel Everywhere. *Business Week European Edition*, 42-50.

Ekberg, J. (2002). *SeniorWatch Technology Watch Report*. Helsinki: STAKES.

EKOS. (2003). *Rethinking the Information Highway*. Ottawa: EKOS Research Associates Inc.

EKOS. (2004). *The Dual Digital Divide IV*. Ottawa: EKOS Research Associates Inc.

Empirica. (2001). *SeniorWatch Study - Tele-service for Seniors: Video telephony-based support for older people*. Bonn, Germany: Empirica Communication and Technology Research.

Feldman, P. H., & Oberlink, M. R. (2003). The AdvantAge Initiative: Developing Community Indicators to Promote the Health and Well-Being of Older People. *Family and Community Health*, 26(4), 268-274.

Garnham, N. (1999). Amartya Sen's Capabilities Approach to the Evaluation of Welfare: Its Application to Communications. In A. Calabrese & J. Burgelman (Eds.), *Communication, Citizenship and Social Policy* (pp. 113-124). Lanjam, ML: Rowman and Littlefield.

Gibbs, C., Adlam, T., Faulkner, R., & Orpwood, R. (2003). Development of a Cooker Monitor for People with Dementia. In G. M. Craddock, L. P. McCormack, R. B. Reilly & H. T. P. Knops (Eds.), *Assistive Technology Research Series: Assistive Technology - Shaping the Future* (Vol. 11). Dublin, Ireland: IOS Press.

Giordano, J. A. (2000). Effective Communication and Counseling with Older Adults. *International Journal of Aging and Human Development*, 51(4), 315-324.

Gitlin, L. N. (2000). Adjusting "Person-Environment Systems" - Helping Older People Live the "Good Life" at home. In R. M. Rubinstein, M; Kleban, M (Ed.), *The Many Dimensions of Aging: Essays in Honor of M. Powell Lawton*. New York: Springer.

Gitlin, L. N. (2002). Assistive Technology in the Home and Community for Older People: Psychological and Social Considerations. In M. J. Scherer (Ed.), *Assistive Technology: Matching Device and Consumer for Successful Rehabilitation*. Washington: American Psychological Association.

Gitlin, L. N. (2003). Conducting Research on Home Environments: Lessons Learned and New Directions. *The Gerontologist*, 43(5), 628-637.

Gitlin, L. N., Mann, W., Tomit, M., & Marcus, S. M. (2001). Factors associated with home environmental problems among community-living older people. *Disability and Rehabilitation*, 23(17), 777-787.

Golant, S. M. (2003). Conceptualizing Time and Behaviour in Environmental Gerontology: A Pair of Old Issues Deserving New Thought. *The Gerontologist*, 43(5), 638-648.

Goodman, J., Gray, P., Khammampad, K., & Brewster, S. (2004). Using Landmarks to Support Older People in Navigation. In M. Dunlop (Ed.), *Proceedings of the 6th International Conference on Human Computer Interaction with Mobile Devices and Services*. Glasgow, Scotland.

Goodman, J., Dickinson, A., & Syme, A. (2004). *Gathering Requirements for Mobile Devices using Focus Groups with Older People*. Paper presented at the 2nd Cambridge Workshop on Universal Access and Assistive Technology, Cambridge, UK.

Goodman, J., Syme, A., & Eisma, R. (2003). *Older Adults' Use of Computers: A Survey*. Paper presented at the HCI 2003, Bath, UK.

Government of Canada. (2002). *Services for Seniors: Guide to Government of Canada Services for Seniors and their Families*. Ottawa: Minister of Public Works and Government Services.

Gregor, P., Newell, A. F., & Zajicek, M. (2002). Designing for Dynamic Diversity - interfaces for older people. In *Proceedings of the fifth international ACM conference on Assistive technologies* (pp. 151 - 156). Edinburgh, Scotland: ACM Press.

Haddon, L. (2000). Social exclusion and information and communication technologies: Lessons from studies of single parents and the young elderly. *New Media & Society*, 2(4), 387-406.

Hagen, I., Holthe, T., Duff, P., Cahill, S., Gilliard, J., Orpwood, R., et al. (2002). A systematic assessment of assistive technology. *Journal of Dementia Care*, 10(1), 26-27.

Hawthorn, D. (2003). How Universal is Good Design for Older Users. In *Proceedings of the 2003 conference on Universal usability* (pp. 38 - 45). Vancouver, British Columbia, Canada: ACM Press.

Hilt, M. L., & Lipschultz, J. H. (2004). Elderly Americans and the Internet: E-Mail, TV News, Information and Entertainment Websites. *Educational Gerontology*, 30, 57-72.

Hirsch, T., Forlizzi, J., Hyder, E., Goetz, J., Kurtz, C., & Stroback, J. (2000). The ELDER project: social, emotional, and environmental factors in the design of eldercare technologies. In *Proceedings on the 2000 conference on Universal Usability* (pp. 72 - 79). Arlington, Virginia, United States: ACM Press.

Holladay, S. J., & Coombs, T. W. (2004). The Political Power of Seniors. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research* (pp. 383-405). Mahwah, NJ: Lawrence Erlbaum Associates.

Horgas, A. L., Wilms, H.-U., & Baltes, M. M. (1998). Daily Life in Very Old Age: Everyday Activities as Expression of Successful Living. *The Gerontologist*, 38(5), 556-568.

Intille, S. S., Kukla, C., Farzanfar, R., & Bakr, W. (2003). Just-in-Time Technology to Encourage Incremental, Dietary Behavior Change. In *Proceedings of the AMIA 2003 Symposium*.

Intille, S. S., Larson, K., & Kukla, C. (2002). Just-In-Time Context-Sensitive Questioning for Preventative Health Care. In *Proceedings of the AAAI 2002 Workshop on Automation as Caregiver: The Role of Intelligent Technology in Elder Care*.

Intille, S. S., Tapia, E. M., Rondoni, J., Beaudin, J., Kukla, C., Agarwal, S., et al. (2003). Tools for Studying Behavior and Technology in Natural Settings. In *Proceedings of UbiComp 2003, the Fifth International Conference on Ubiquitous Computing* (pp. 157 - 174). Seattle, Washington, USA: Springer-Verlag Heidelberg.

Jacobs, A. R., & Abowd, G. D. (2003). A Framework for Comparing Perspectives on Privacy and Pervasive Technologies. *IEEE Pervasive Computing*, 2(3), 78-84.

Jessome, J., Parks, C., Burkhart, L., Ingram, E. L., Laidlaw, S., MacLellan, M., et al. (2001). *Everyday Technology and Older Adults: Friends or Foes?* Halifax: Mount Saint Vincent University.

Kanayama, T. (2003). Ethnographic research on the experience of Japanese elderly people online. *New Media & Society*, 5(2), 267-288.

Kankainen, A., & Oulasvirta, A. (2003). Design Ideas for Everyday Mobile and Ubiquitous Computing Based on Qualitative User Data. *Lecture Notes in Computer Science*, 2615, 458-464.

Keating, N., & Cook, L. H. (2001). Current thinking in gerontology in Canada. *Ageing and Society*, 21, 131-138.

Kidd, C. D., Orr, R. J., Abowd, G. D., Atkeson, C. G., Essa, I. A., MacIntyre, B., et al. (1999). The Aware Home: A Living Laboratory for Ubiquitous Computing Research. In *Proceedings of the Second International Workshop on Cooperative Buildings: Integrating Information, Organization and Architecture*. Pittsburgh, USA.

Koncelik, J. A. (2002). The Human Factors of Aging and the Micro-Environment: Personal Surroundings, Technology and Product Development. *Journal of Housing for the Elderly*, 17(1-2), 117-134.

Korhonen, I., Parkka, J., & Gils, M. V. (2003). Health Monitoring in the Home of the Future, *IEEE Engineering in Medicine and Biology Magazine* (Vol. 22, pp. 66-73).

Kostakos, V., & O'Neill, E. (2004). *Pervasive Computing in Emergency Situations*. Paper presented at the The 37th Hawaii International Conference on Systems Science, Hawaii.

Krout, J. M., P; Holmes, HH; Oggins, J; Bowen, N. (2002). Reasons for Relocation to a Continuing Care Retirement Community. *Journal of Applied Gerontology*, 21(2), 236-256.

Kurosu, M., & Kashimura, K. (1995). Apparent Usability vs. Inherent Usability: Experimental Analysis on the Determinants of the Apparent Usability. In *Proceedings of ACM CHI'95 Conference on Human Factors in Computing Systems* (Vol. 2, pp. 292-293).

Lehoux, P., & Blume, S. (2000). Technology Assessment and the Sociopolitics of Health Technologies. *Journal of Health Politics, Policy and Law*, 26(6), 1983-1120.

Litwak, E., & Longino, C. (1987). Migration patterns among the elderly: A developmental perspective. *The Gerontologist*, 27, 266-272.

Longino, C. (2002). Pandora's Briefcase: Unpacking the Retirement Migration Decision. *Research on Ageing*, 24(1), 29-49.

MacKenzie, D., & Wajcman, J. (Eds.). (1985). *The Social Shaping of Technology*. Milton Keynes: Open University Press.

MacKnight, C., Latta, R., Devichand, P., Fisk, J., & Kirkland, S. (2003). Rate of Nursing Home Placement in Rural and Urban Seniors: Results from the Canadian Study of Health and Aging. *Journal of the American Geriatrics Society*, 51(4: P5000 Suppl. S), S211.

Mahoney, D. F., Tarlow, B. J., & Jones, R. N. (2003). Effects of an Automated Telephone Support System on Caregiver Burden and Anxiety: Findings from the REACH for TLC Intervention Study. *The Gerontologist*, 43(4).

Mann, W. C., Ottenbacher, K. J., Fraas, L., Tomita, M., & Granger, C. V. (1999). Effectiveness of assistive technology and environmental interventions in maintaining independence and reducing home care costs for the frail elderly. A randomized controlled trial. *Archives of Family Medicine*, 8(3), 210-217.

Mares, M.-L., & Fitzpatrick, M. A. (2004). Communication in Close Relationships of Older People. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research* (pp. 231-249). Mahwah, NJ: Lawrence Erlbaum Associates.

Marmasse, N., & Schmandt, C. (2003). Safe & sound: a wireless leash. In *CHI '03 extended abstracts on Human factors in computing systems* (pp. 726-727). Fort Lauderdale, FL, USA: ACM Press.

Maslow, A. (1968). *Toward a Psychology of Being. 2nd edition*. New York: Van Nostrand Reinhold.

McIver, W. J. (2001). *Integrating Critical Theory into Studies of the Digital Divide*. Unpublished manuscript, University at Albany, SUNY.

McIver, W. J., & Prokosch, A. P. (2000). *Towards a Critical Approach to Examining the Digital Divide*. Paper presented at the ISTAS 2002, Raleigh, North Carolina.

McKay, V. C., & Caverly, R. S. (2004). The Nature of Family Relationships Between and Within Generations. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research* (pp. 251-271). Mahwah, NJ: Lawrence Erlbaum Associates.

Miller, C. A., Wu, P., Krichbaum, K., & Kiff, L. (2004). *Automated Elder Home Care: Long Term Adaptive Aiding and Support We Can Live With*. Paper presented at the 2004 AAAI Spring Symposium Workshop on Interactions Between Humans and Autonomous Systems over Extended Operation, Palo Alto, CA.

Moore, G. E. (1965). Cramming More Components Onto Integrated Circuits. *Electronics*, 38(8).

Morrell, R. W., Park, D. C., Mayhorn, C. B., & Echt, K. V. (1995). Older Adults and Electronic Communications Networks: Learning to use ELDERCOMM. In W. A. Rogers, A. D. Fisk & N. Walker (Eds.), *103rd Annual Convention of the American Psychological Association*. New York.

Morrell, R. W., Dailey, S. R., Feldman, C., Mayhorn, C. B., & Echt, K. V. (2001). *Older Adults and Information Technology: A Compendium of Scientific Research and Web Site Accessibility Guidelines*. Bethesda, Maryland: National Institute on Aging.

Mosco, V. (1998). *Learning to be a Citizen of Cyberspace*. Paper presented at the Transition to the Knowledge Society: Policies and Strategies for Individual Participation and Learning, Vancouver.

Moss, M., & Lawton, M. P. (1982). Time Budgets of Older People: A Window on Four Lifestyles. *Journal of Gerontology*, 37(1), 115-123.

Murdock, G. (1986). Poor connections: income inequality and the 'information society'. In P. Golding (Ed.), *Excluding the Poor*. London: Child Poverty Action Group.

Murdock, G. (2002). Rethinking Communication Exclusion: Tackling the Digital Divide. In BECTa (Ed.), *Digital Divide*: Coventry.

Murdock, G., & Golding, P. (1989). Information Poverty and Political Inequality: Citizenship in the Age of Privatized Communications. *Journal of Communication*, 39(3), 180-195.

Mynatt, E. D., Rowan, J., Craighill, S., & Jacobs, A. (2001). Digital family portraits: supporting peace of mind for extended family members. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 333-340). Seattle, Wa., USA: ACM Press.

Nie, N. H. (2001). Sociability, Interpersonal Relations, and the Internet: Reconciling Conflicting Findings. *American Behavioral Scientist*, 45(3), 420-435.

Norman, D. A. (2004). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books.

Noury, N., Virone, G., Barralon, P., Ye, J., Rialle, V., & Demongeot, J. (2003). New Trends in Health Smart Homes. In *5th IEEE International Workshop on Enterprise Networking and Computing in Healthcare Industry* (pp. 111-117). Santa Monica, California: IEEE.

Nygaard, L., & Starkhammer, S. (2003). Telephone use among non-institutionalized persons with dementia living alone: Mapping out difficulties and response strategies. *Scandinavian Journal of Caring Sciences*, 17(3), 239-249.

O'Donnell, S. (2003). *The Internet and Older Citizens*. Paper presented at the European Conference on a Ministerial Level on Gender and the Information Society, Athens.

OECD. (2001). *The New Economy - Beyond the Hype. The OECD Growth Project*. Paris: OECD.

OECD. (2002). *OECD Information Technology Outlook: ICTs and the Information Economy*. Paris: OECD.

Ogawa, M., & Togawa, T. (2003). The concept of home health monitoring. In *5th IEEE International Workshop on Enterprise Networking and Computing in Healthcare Industry* (pp. 71-73). Santa Monica, California: IEEE.

Orpwood, R., Faulkner, R., Gibbs, C., & Adlam, T. (2003). A Design Methodology for Assistive Technology for People with Dementia. In G. M. Craddock, L. P. McCormack, R. B. Reilly & H. T. P. Knops (Eds.), *Assistive Technology Research Series: Assistive Technology - Shaping the Future* (Vol. 11). Dublin, Ireland: IOS Press.

Orr, R. J., & Abowd, G. D. (2000). The smart floor: a mechanism for natural user identification and tracking. In *CHI '00 extended abstracts on Human factors in computing systems* (pp. 275-276). The Hague, The Netherlands: ACM Press.

Oswald, F., Shilling, O., Wahl, H.-W., & Gang, K. (2002). Trouble in Paradise? Reasons to Relocate and Objective Environmental Changes Among Well-Off Older Adults. *Journal of Environmental Psychology*, 22, 273-288.

Park, S. H., Won, S. H., & Lee, J. B. (2003). Smart home - digitally engineered domestic life. *Personal and Ubiquitous Computing*, 7(3-4), 189-196.

Pecchioni, L. L., Ota, H., & Sparks, L. (2004). Cultural Issues in Communication and Aging. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research (2nd edition)*. Mahwah, NJ: Lawrence Erlbaum Associates.

Pentland, A. (2004). Healthwear: Medical Technology Becomes Wearable. *Computer*, 37(5), 42-49.

Petty, L. S. (2001). *High Technology Reading and Writing Devices for People with Vision Problems*. Paper presented at the International Conference on Technology and Aging, Toronto.

Prime Minister's Task Force on Active Living and Dignity for Seniors. (2004). *Creating a National Seniors Agenda*. Ottawa: Tony Ianno, MP.

Rawlins, W. K. (2004). Friendships in Later Life. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research* (pp. 273-299). Mahwah, NJ: Lawrence Erlbaum Associates.

Rialle, V., Duchene, F., Noury, N., Bajolle, L., & Demongeot, J. (2002). Health "Smart" Home: Information Technology for Patients at Home. *Telemedicine Journal and e-Health*, 8(4), 395-409.

Rideout, V. (2000). Public Access to the Internet and the Canadian Digital Divide. *Canadian Journal of Information and Library Science*, 25(2-3), 1-21.

Robinson, J. D., Skill, T., & Turner, J. W. (2004). Media Usage Patterns and Portrayals of Seniors. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ryan, E. B., Bajorek, S., Anas, A. P., & Beamer, M. (2001). *Older Adults' Use of Technology to Maintain Reading after Vision Loss*. Ottawa: National Advisory Council on Aging.

Ryan, J. (2001). *Technology and Older Adults: A Senior's Perspective*. Ottawa: National Advisory Council on Aging.

Sachs, N. A., Nulud, P. L., & Loeb, G. E. (2003). Virtual Visit(TM): Improving Communication for Those Who Need it Most. In J. Westwood (Ed.), *Medicine meets virtual reality II* (pp. 302-308). Amsterdam: IOS Press.

Savenstedt, S., Zingmark, K., & Sandman, P. (2003). Video-phone communication with cognitively impaired elderly patients. *Journal of Telemedicine and Telecare*, 9 (Suppl. 2), S2:52-54.

Schenker, J. L. (2000, 28th February, 2000). Not Very PC. *TIME Europe*, 155.

Schneiderman, B. (2002). *Leonardo's Laptop: Human Needs and the New Computing Technologies*. Cambridge, Massachusetts: MIT Press.

Selwyn, N., Gorard, S., Furlong, J., & Maddon, L. (2003). Older adults' use of information and communications technology in everyday life. *Aging & Society*, 23, 561-582.

Sen, A. (1999). *Development as Freedom*. New York: Anchor Books.

Steggles, E., & Leslie, J. (2001). *Simple Technology to Enhance Independent Living*. Paper presented at the International Conference on Technology and Aging, Toronto.

Stewart, M., Mann, K., Jackson, S., Downe-Wamboldt, B., Bayers, L., Slater, M., et al. (2001). Telephone Support Groups for Seniors with Disabilities. *Canadian Journal on Aging*, 20(1), 47-72.

Strain, L. A., Grabusic, C. C., Searle, M. S., & Dunn, N. J. (2002). Continuing and Ceasing Leisure Activities in Later Life: a Longitudinal Study. *The Gerontologist*, 42(2), 217-223.

Straka, S. M., & Clark, F. (2000). *Connections: Internet Access for Frail Older Seniors to Improve their Psychosocial Well-Being*. Montreal: The McGill Centre for Studies in Aging.

Szymkowiak, A., Morrison, K., Inglis, E. A., Gregor, P., Shah, P., Evans, J. J., et al. (2003). A memory aid with remote communication for elderly and memory-impaired users. In C. Stephanidis (Ed.), *Proceedings of HCI International 2003* (pp. 902-906). Crete, Greece: Lawrence Erlbaum Associates, Inc.

Vicente, K. (2003). *The Human Factor: Revolutionizing the Way People Live With Technology*. Toronto: Alfred A. Knopf Canada.

Wagner, L. S., & Wagner, T. H. (2003). The Effect of Age on the Use of Health and Self-Care Information: Confronting the Stereotype. *The Gerontologist*, 43(3), 318-324.

Wahl, H.-W., & Weisman, G. D. (2003). Environmental Gerontology at the Beginning of the New Millennium: Reflections on Its Historical, Empirical, and Theoretical Development. *The Gerontologist*, 43(4), 616-627.

White, H., McConnell, E., Clipp, E., Branch, L., Sloane, R., Pieper, C., et al. (2002). A randomized controlled trial of the psychosocial impact of providing internet training and access to older adults. *Aging & Mental Health*, 6(3), 213-221.

Wiles, J. (2003). Informal caregivers' experiences of formal support in a changing context. *Health and Social Care in the Community*, 11(3), 189-207.

Williamson, K., Schauder, D., Wright, S., & Stockfeld, L. (2001). *Enabling Older People With Disabilities to Connect With Others Across the World: an Australian Perspective*. Victoria, Australia: Monash University.

Wilson, B. A., Emslie, H. C., K. Quirk, & Evans, J. J. (2001). Reducing everyday memory and planning problems by means of a paging system: a randomised control crossover study. *Journal of Neurology, Neurosurgery & Psychiatry*, 70(4), 477-482.

Wilson, G. (2001). Psychophysiological Indicators of the Impact of Media Quality on Users. In *Extended Abstracts of CHI 2001* (Vol. II, pp. 95-97). Seattle, Wa.: ACM Press.

World Health Organization. (2001). *International classification of functioning, disability and health: ICF*. Geneva: World Health Organization.

Wright, K. (2000). Computer-mediated Social Support, Older Adults, and Coping. *Journal of Communication*, 50(3), 100-118.

Wright, K. B., & Query, J. L. (2004). Online Support and Older Adults. In J. F. Nussbaum & J. Coupland (Eds.), *Handbook of Communication and Aging Research* (pp. 499-519). Mahwah, NB: Lawrence Erlbaum Associates.

Yates, A., Etzioni, O., & Weld, D. (2003). A reliable natural language interface to household appliances. In *Proceedings of the 8th international conference on Intelligent user interfaces* (pp. 189-196). Miami, FL, USA: ACM Press.

Zunzunegui, M.-V., Alvarado, B. E., Ser, T. D., & Otero, A. (2003). Social Networks, Social Integration, and Social Engagement Determine Cognitive Decline in Community-Dwelling Spanish Older Adults. *Journal of Gerontology: Social Sciences*, 58B(2), S93-S100.

Appendix 1: Project consultations to date

1. Industry Canada – Minister’s Advisory Committee on Assistive Devices and Persons with Disabilities, Ottawa, February 19th 2004

Participants: Ed Biden, Gary Birch, Mel Graham, Charles Laszlo, Mickey Milner, Beverley Milligan and Paul Mitten, Cathy Moore, Ralph Manning, Deb. Finn, Dave Flanagan, Mary Frances Laughton, Lawrence Euteneier and Chuck Letourneau

2. Consultation with groups working with seniors, Fredericton, March 4th 2004

Participants: Colleen Hanna, Sheila Laidlaw, Jo Lynam.

Appendix 2: Glossary

Aging in place

Senior citizens aging in a home environment that is not an institution.

Assistive device

A device used to increase, maintain or improve functional capabilities of an individual with a disability. If designed correctly assistive devices will be acceptable to all users. A walking cane is a simple example of an assistive device.

Assistive Technology (AT)

Technology which is designed primarily to enable a disabled user perform at level comparable to a user that is not disabled.

Bluetooth

A short range, wireless communication protocol which is primarily designed to allow multiple devices carrier by or near a user to communicate at 720kbps. Official website: www.bluetooth.org

Broadband

This is high speed internet access (anything from 128 kb/s to 3Mb/s) which frees the phone line and is permanently connected. Access may be via a telephone or cable television system.

Dial-Up Internet Access

This is relatively slow Internet access (up to 56 kb/s) which uses the regular phone line to connect. Connections must explicitly be made (i.e. it is not always on) and it is not possible to use a phone while connected.

Disappearing computer

See Ubiquitous computing.

Environmental Interventions (EI)

Changes made to a senior's home environment that enable them to age in place. Examples of environmental interventions include the addition of ramps and the lowering of kitchen cabinets.

Environmental gerontology

The study of seniors in their socio-spacial surroundings.

Global Positioning System (GPS)

Initially designed by the US Department of Defence for military use GPS allows devices to receive signals from four satellites which enable the device to calculate their approximate location. Prior to 2000 two versions were available: Precise Positioning Service (PPS) which had availability limited to US government approved users and provided an accuracy to within approximately 20 metres; and Standard Positioning

Service (SPS) which was widely available and provided an accuracy to within 100 metres. As of 2000 the SPS signal was made as accurate as the PPS signal.

Interactive Television (ITV)

A television service which enables users to interact directly with the television content. This is in contrast with the normal model of television which provides no means for user interaction other than passive viewing. This interaction may range from the selection of viewing options (such camera angles or audio tracks) to the provision of two-way communication with the content provider.

Human-Computer Interaction (HCI)

The computing science research field concerned with improving the means by which human users can interact with computers

ICF

The International Classification of Functioning, Disability and Health, a publication of the World Health Organization in Geneva.

ICT

Information and communication technologies. The term most commonly refers to the Internet and technologies linked by electronic networks but also covers all electronic information and communication media, devices and applications, such as radio, television, telephony and mobile telephony, handheld communication devices, computers and peripherals including game consoles, and multimedia storage devices such as CD ROMs and MPEG.

Local Area Network (LAN)

A network used to connect multiple computers together in, for example, an office environment. Such a network would typically be capable of connection speeds of up to 100Mb/s. The term LAN does not specify how the connections are made but typically they are wired.

Pervasive computing

See Ubiquitous computing.

Senior citizen

A person aged 65 or over.

Seniors and ICT

The name of the research project led by the NRC-IIT.

Smart Homes

Homes that have been enhanced with sensor technology and the ability to process the acquired data and react appropriately. Smart home technology can range from a simple

sensor that detects the presence of someone and switches the light on to fall detectors which can alert emergency services if a senior falls.

Ubiquitous computing

Also known as pervasive computing or the disappearing computer, ubiquitous computing is the term used to describe how computers are no longer limited in location or format but are becoming part of the fabric of our society.

WHO

The World Health Organization in Geneva.

WiFi

A series of mid-range wireless communication protocols (802.11a, b and g) which are designed to allow computers to connect to a network within the same building or city block. Connection speeds vary from 11 to 54 Mb/s. Typically used instead of building a wired LAN or as a complement to an existing LAN.