The Effect of Hearing Loss and Hearing Aids on the Use of Information and Communication Technologies by Community-Living Older Adults*

Chris Gonsalves and Margaret Kathleen Pichora-Fuller
Department of Psychology, University of Toronto

RÉSUMÉ

Les innovations en technologies de l'information et de la communication transforment la société. Toutefois, parmi les aînés résidant au Canada, seulement 1 sur 15 utilisait un ordinateur au tournant du millénium, et 1 sur 5 éprouve des difficultés auditives, visuelles ou de communication (Statistique Canada, 2000). Le but premier de l'étude est d'étudier le lien entre la déficience auditive et l'utilisation des technologies de l'information et de la communication chez les aînés. Un questionnaire portant sur l'utilisation des technologies a été administré à 135 aînés chez qui l'audition a été mesurée par audiométrie. Une corrélation a été démontrée entre l'audition et l'étendue d'utilisation des technologies de la communication, particulièrement en ce qui concerne les technologies nouvelles et spécialisées. Les aînés avec déficience auditive qui ne portent pas d'appareils auditifs n'utilisent pas d'autres technologies aussi fréquemment que leurs pairs ayant une bonne audition ou même ceux qui utilisent des appareils auditifs. De façon générale, l'aptitude et l'étendue d'utilisation des technologies de l'information et de la communication étaient plus élevés au sein de l'échantillon à l'étude comparativement aux résultats rapportés pour un échantillon national. Toutefois, les patrons d'utilisation des diverses technologies ainsi que les facteurs influençant leur utilisation étaient similaires dans les deux échantillons. Des recommandations touchant les études futures, les programmes d'éducation à la santé et la conception universelle sont proposées.

ABSTRACT

Innovations in information and communication technologies are changing society, but only 1 in 15 Canadian seniors used a computer at the turn of the millennium (Statistics Canada, 2000). Furthermore, about 1 in 5 Canadian seniors has difficulty hearing, seeing, or communicating. The primary goal of the study was to investigate the relationship between hearing impairment and the use of information and communication technologies by older adults. A questionnaire about use of technologies was administered to 135 older adults and hearing was measured using audiometry. Hearing was found to be related to the extent of use of communication technologies, especially newer and more specialized technologies. Those with hearing loss who did not use a hearing aid did not use other technologies as much as peers with good hearing or hearing-aid users. Overall, the extent of and ability to use information and communication technologies was greater for the study sample than in previous findings for a national sample; however, the patterns of usage of various technologies and the factors influencing use were similar in the two samples. Recommendations are made for future research, health education programs, and universal design.

* This study was conducted to fulfil the requirements of CCT 405, an independent project course in the Human Communication and Technology Specialization of the Communication, Culture, and Information Technology Program at the University of Toronto at Mississauga. We wish to thank Christine De Luca for conducting the hearing tests and Elizabeth Olszewska for recruiting volunteers to complete the survey. We also wish to thank Véronique Vaillancourt from the Programme d'audiologie et d'orthophonie, École des sciences de la réadaptation, Université d'Ottawa for translating the abstract into French. This work was presented as a poster at the Canadian Gerontological Association annual conference in Quebec City in October 2006.

Manuscript received: / manuscrit reçu : 24/08/06

Manuscript accepted: / manuscrit accepté : 31/03/08

Mots clés : vieillissement, technologie des communications, technologie de l'information, pertes auditives, prothèses auditives

Keywords: aging, communication technology, information technology, hearing loss, hearing aid

Requests for offprints should be sent to: / Les demandes de tirés-à-part doivent être adressées à :
M. Kathleen Pichora-Fuller, Ph.D.
Department of Psychology
University of Toronto
3359 Mississauga Rd. N.
Mississauga, ON L5L 1C6
(k.pichora.fuller@utoronto.ca)

Over the last decade, there have been amazing innovations in information and communication technologies. Remarkable new technologies have become part of everyday life in Canadian society and worldwide. Most notably, it has become common for businesses, government, and individuals to exchange information using the Internet. At the same time, older technologies such as television and the telephone have been redesigned, with many people using portable models or installing wireless units in multiple rooms in their homes. Ubiquitous information and communication technologies have increased the ease and frequency of communication for most people. Furthermore, following a trajectory foreseen 40 years ago, new technologies have continued to take advantage of the integration of video and audio in multimodal media (McLuhan & Fiore, 1968). It has become ordinary for communication to take place almost instantly across continents. People can see and talk with a friend in a distant country via a Web-based videoconference or instantly transmit a movie with a cell phone. Whether for the purposes of entertainment, transacting business, or finding information, most people in modern society take for granted that individuals around the world can participate by using interactive and multi-modal information and communication technologies.

At present, information and communication technologies are used by all generations. Young adults today become experts in using these technologies at an early age. Aging adults in the baby-boom generation who are entering retirement have been the architects and witnesses of remarkable advances in information and communication technologies. Furthermore, although these innovations may be less familiar to older seniors, this age group in the population stands to benefit from such technological developments in important ways that they may never have imagined. New, more advanced, yet more widely used technologies may enable seniors who would otherwise become isolated to remain connected with a richer social network. There is an increased reliance on caregivers and a concomitant increase in the risks associated with living alone as aging occurs. In such situations, the use of information and communication technologies may play an even more important role in helping seniors to maintain independence and a better quality of life.

Despite the possible benefits to seniors of using new technologies, rapid advances may challenge seniors who do not adapt easily to technological changes (Czaja et al., 2006). Indeed, many studies suggest that older adults have been excluded from using information and communication technologies (Hanley, 2002; Madden & Savage, 2000; Teo, 2001) and that increasing age is negatively correlated with the use of communication technologies (Selwyn, Gorard, Furlong, & Madden, 2003). Some of the reasons that explain why older adults adopt the more generic communication technologies less than younger adults include costs, lack of access to technology, lack of skills in operating the technology, anticipated difficulty with learning to use the technology, increased anxiety, reduced confidence in ability to use the technology, and negative attitudes toward technology. Thus, a combination of attitudinal and cognitive factors seems to predict success in older adults' adopting new technologies (Czaja et al., 2006).

The older generation's lack of experience with modern technology may also explain why they use it less than younger seniors do. Importantly, the adoption of technology can be facilitated by a positive attitude toward technology and positive self-efficacy beliefs (Czaja et al., 2006). Structured training can be useful for building skills and confidence for those who are more anxious and who have lower self-efficacy (Czaja et al., 2006). Nevertheless, while 98 per cent of the Canadian population 65 years of age or older have received computer training at some time in their life, only 1 in 15 seniors reported using a computer in the 12 months before a study in which they were surveyed at the turn of the millennium (Statistics Canada, 2000).

In addition to factors that have already been linked to the lower use of information and communication technologies by older adults, sensory declines also seem to be a factor that could influence the extent to which older adults use and benefit from various information and communication technologies. The greater prevalence of sensory impairments among seniors raises questions about whether these

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

impairments are a barrier to the use of new technologies. Furthermore, it may be especially important to ensure that older adults with sensory loss can benefit fully from these technologies to overcome reductions in communication function associated with sensory impairments.

Numerous researchers have documented age-related sensory changes (e.g., Davis, 1995; Gates, Cooper, Kannel, & Miller, 1990; Gibson, Lavery, & Rosenthal, 1986; Gillman, Simmel, & Simon, 1986; Wormald, Wright, Courtney, Beaumont, & Haines, 1992). Both cross-sectional and longitudinal research indicates that older adults with unremediated vision and/or hearing loss experience significantly poorer quality of life and cognitive function, as well as significantly higher mortality, compared to those with remediated or normal sensory function (Appolonio, Carabellese, Frattola, & Trabucchi, 1996; Scherer & Frisina, 1998; Seniors Research Group, 1999). Auditory and visual function play a role through their effects on both general health and social relationships. Most notably, visual and hearing impairments may directly affect how well an older adult can communicate. Loss of communication, in turn, often results in isolation, with increased susceptibility to depression (e.g., Cacciatore et al., 1999; Mulrow, Tuley, & Aguilar, 1992; Naramura et al., 1999). The ability to communicate plays an important role in maintaining a healthy and satisfactory lifestyle (Hummert & Nussbaum, 2000), but quality of life may be compromised by sensory loss.

Breakdowns in communication can hamper the interpersonal interactions, involving conversation or the enjoyment of many communication-demanding leisure activities, usually associated with a satisfactory lifestyle (Marsiske, Klumb, & Baltes, 1997). To enable participation in communication-demanding leisure activities (e.g., reading the newspaper, attending concerts), seniors with sensory loss often wear corrective lenses or hearing aids or use specialized assistive technology. Just as more dedicated assistive technology has done in the past (for a review, see Lubinski & Higginbotham, 1997), modern information and communication technology produced for a general market may be beneficial for older adults who have increasing sensory, mobility, and cognitive difficulties. For example, an older adult with limitations in hearing who is unable to communicate on the telephone could use a primarily visual and now common communication technology, such as fax or e-mail, to communicate. A decade ago, the same individual, unable to communicate using a conventional telephone, might have resorted to learning how to use a specialized and expensive assistive technology, such as a telecommunications device for the deaf (TDD), to type her/his message. A number of studies have explained the link between communication and sensory losses with a view to improving the lives of older adults (e.g., Erber & Heine, 1996; Laforge, Spector, & Sternberg, 1992). The information and communication technologies that have enabled global interactivity could help to promote older individuals' psychological and social well-being. Nevertheless, there has been little research on the impact of age-related sensory loss on the use of most everyday communication technologies.

The main purpose of the present study was to investigate how sensory factors, in particular hearing loss and the use of hearing aids, are related to older adults' extent of use and ability to use a broad variety of common communication technologies. We expected that seniors with well-preserved sensory functioning would use communication technologies to a greater extent and use them better than those with lower sensory functioning. We focused our analysis of sensory factors on hearing rather than vision because it is less common for people to use hearing aids than corrective lenses and it is well known that hearing aids are less effective than lenses at compensating for lost function (for reviews, see Lubinski & Higginbotham, 1997). Accordingly, we set out to determine if quantitative, objective audiometric measures of hearing loss and self-reported hearing-aid use were related to participation in communication-demanding leisure activities and to the use of standard information and communication technologies. Another purpose of the study was to compare the results we obtained for a sample of older adults participating in university-based research on aging and communication to similar information that was available from an earlier survey of a national sample of seniors.

Method

Participants

The participants in the study were 135 adults 65 years of age or older (mean age = 74.3 years, $SD = 5.2$, *range* = 23 years) who were residents of a major urban centre. They were recruited from a pool of approximately 1,000 healthy older adults who had volunteered to participate in university laboratory research on communication and aging. Those invited to participate in the study were selected randomly from the pool of volunteers by the regular staff outreach coordinator, with the only eligibility criteria being age (65 years or older) and successful participation in a previous experiment. The first 150 volunteers who agreed to complete the questionnaire and to allow us to access sensory and demographic

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

information that was already on file were recruited during a period of about 4 months in early 2006. Of the 150 who were recruited, all participants completed the questionnaire, but 15 were dropped from the analysis because of incomplete information on at least one of the measures. The study was approved by the university ethics review board, and all participants provided informed consent.

Demographic information about the participants that might influence their use of information and communication technologies or their participation in communication-demanding leisure activities was gathered from existing lab records. The volunteers ranged in age from 65 to 87 years of age and included 64 (47.4%) men and 71 (52.6%) women. Most of the volunteers spoke English as their first language ($N = 118$; 87.4%). The majority of our volunteers had received at least some post-secondary education: 28 (20.8%) had begun, but not completed, studies at college or university; 56 (41.5%) had completed post-secondary education at the bachelor's level; 18 (13.3%) had completed a degree at the graduate level. Those who had no post-secondary education included 24 (17.8%) who had completed high school, and only 9 (6.7%) who had not completed high school. With the same occupation categories as Statistics Canada (2000), professional was the most common category in our sample ($N = 50$; 37%), followed by clerical ($N = 27$; 20%) and sales ($N = 26$; 19.3%), then by management ($N = 14$; 10.4%) and technologist ($N = 12$; 8.9%), with only 3 (2.2%) having worked in trades and another 3 (2.2%) not having worked. The method of transportation used by the majority of the volunteers was to drive a car ($N = 114$; 84.4%) or to be driven by someone else ($N = 12$; 8.9%), with only 9 (6.7%) taking public transportation. Almost all participants wore corrective lenses for vision problems ($N = 130$; 96.3%).

Measures

Pure-tone air-conduction hearing thresholds measured using standard audiometric procedures (see Mencher, Gerber, & McCombe, 1997) with a clinical audiometer in a double-walled sound-attenuating booth were obtained from recently updated research records. Participants completed a new questionnaire concerning their participation in communication-demanding leisure activities, their frequency of use and ability to use information and communication technologies, and their use of assistive technology.[1] To facilitate comparisons between our sample of seniors and national data, the questions and response options for many items in the present survey were designed to be similar to those used previously by Statistics Canada (Statistics Canada, 1998; Statistics Canada, 2000).

Some participants were mailed a questionnaire and were asked to return it in the self-addressed stamped envelope that was provided, while others completed the questionnaire when they came to participate in other studies at the university. Precautions were taken to minimize possible differences between those who completed the questionnaire at home and those who completed it at the university by controlling the test environment at the university. Specifically, the participants who completed the questionnaire at the university worked alone in a quiet room. If a participant completing the questionnaire at the university had a question or concern regarding the questionnaire then s/he was instructed to ask the receptionist to call the researcher who would then provide the necessary clarification. Similarly, if a participant completing the questionnaire at home had a question or concern then s/he was instructed to telephone the researcher who would return their call as soon as possible. Few participants had questions or concerns and there were no apparent differences in the issues raised as between those who completed the questionnaire at the university and those who completed it at home. The effort made by those who completed the questionnaire in the one location was considered comparable to that of those who completed it in the other location: those who completed the questionnaire at the university made an extra effort by attending an appointment, and those who completed it at home made an extra effort by mailing the questionnaire. The seniors in the present sample no doubt differed from a general population sample because they had self-selected by volunteering to participate in research, and they usually demonstrated outstanding dedication to their role as research volunteers.

Analysis

The hearing thresholds and hearing-aid use of the sample were characterized. Further analyses were conducted for the entire sample and for three groups of interest: (a) those with normal hearing, (b) those using a hearing aid, and (c) those with uncorrected hearing loss. Specifically, we examined the proportion of the sample participating in communication-demanding leisure activities, the extent of use of information and communication technologies, and ability to use these technologies. We also examined the relationship between the extent of use of and ability to use each technology.

Results

Hearing Profile of Participants

Audiometric measures of pure-tone air-conducted hearing thresholds indicated that over half of our

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

participants ($N = 83$; 61.5%) had clinically normal hearing in the speech range in their better ear (defined as the average of the pure-tone air-conduction thresholds at 500, 1,000, 2,000 and 3,000 Hz being less than or equal to 25 dB HL; Mencher et al., 1997). About a quarter ($N = 34$; 25.2%) had a mild hearing loss (pure-tone average threshold between 25 and 40 dB HL in the better ear). About 1 in 8 ($N = 17$; 12.6%) had a moderate hearing loss (pure-tone average threshold between 40 and 55 dB HL in the better ear). Only one person had a severe hearing loss (pure-tone average threshold between 55 and 70 dB HL in the better ear).

Although the 52 (38.5%) who had a hearing loss in their better ear would be considered to be candidates for a hearing aid, only about a fifth of the entire sample ($N = 28$; 20.7%), or just over a half (53.9%) of those who were candidates, actually had a hearing aid. Of these 28 participants, 16 had a moderate or severe degree of hearing loss, 11 had a mild hearing loss in their better ear, and one person had normal hearing in the better ear but a hearing loss in the other ear. Of those who did not have a hearing aid ($N = 107$; 79.3%), most had normal hearing, but 23 had a mild hearing loss and 2 had a moderate hearing loss. Further analyses were conducted for three groups categorized according to whether or not the participant had a hearing loss and hearing aid. The normal hearing category included 82 people with normal hearing and no hearing aid; the uncorrected hearing loss category included 25 people with a hearing loss but no hearing aid; the corrected hearing loss category included 28 people with a hearing aid.

Participation in Leisure Activities

The proportion of the sample participating in various leisure activities requiring communication was determined. Figure 1 illustrates the percentage of seniors in our sample and in a national sample (Statistics Canada, 1998) who participated in 13 leisure activities. For all leisure activities, a higher percentage of seniors in our sample participated compared to those in the national sample. Nevertheless, the ranking of the popularity of leisure activities was similar, with the most frequent leisure activity for seniors in our sample and in the national sample being reading (newspapers, magazines, and books), followed by attending concerts and movies, and then by visiting libraries, museums, and art galleries.

Figure 2 shows the percentage of seniors in our sample in the normal, corrected, and uncorrected hearing categories who participated in each communication-demanding leisure activity. More than 90 per cent of those in all three groups reported reading

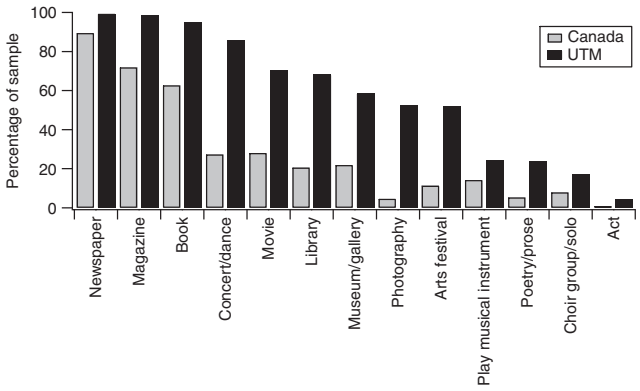

Figure 1: Leisure activities of older adults in the present sample and in a national sample

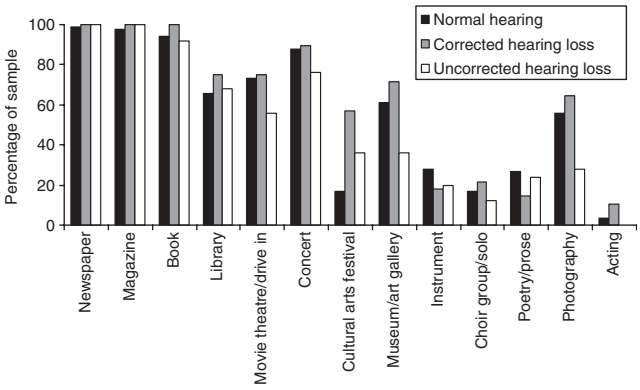

Figure 2: Participation in leisure activities by those in the three sub-groups—normal hearing, corrected hearing loss, and uncorrected hearing loss

newspapers, magazines, and books. For the 10 leisure activities where the participation rate fell below 90 per cent, the rate of participation was the highest for the sub-group with corrected hearing loss for all activities except two, playing a musical instrument and writing poetry/prose. In contrast, those with uncorrected hearing loss had the lowest rate of participation for six of the ten less popular activities, including activities that rely heavily on hearing, such as watching movies and attending concerts. The sub-group with uncorrected hearing loss did not participate more than the other two groups in any of the activities. Significant differences between groups were found for two leisure activities—photography and going to a museum or art gallery; however, with Bonferroni correction, the group differences did not reach significance for any of the activities. Specifically, there were no differences among the groups for the three activities with a participation rate greater than 90 per cent—newspaper ($\chi^2(2) = 0.651$, $p = 0.72$), magazine ($\chi^2(2) = 1.312$, $p = 0.51$), and book ($\chi^2(2) = 2.073$, $p = 0.35$); for the six activities in which the

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

participation rate was lowest for those with uncorrected hearing—movie theatre ($\chi^2(2) = 3.072$, $p = 0.21$), concert ($\chi^2(2) = 2.537$, $p = 0.28$), museum or art gallery ($\chi^2(2) = 7.349$, $p = 0.025$), choir/group/solo ($\chi^2(2) = 0.831$ $p = 0.66$), photography ($\chi^2(2) = 8.004$, $p = 0.018$), and acting ($\chi^2(2) = 3.874$, $p = 0.14$); or for the remaining four activities—library ($\chi^2(2) = 0.805$, $p = 0.66$), cultural arts festival ($\chi^2(2) = 3.131$, $p = 0.21$), musical instrument ($\chi^2(2) = 1.502$, $p = 0.47$) and writing poetry/prose ($\chi^2(2) = 1.817$, $p = 0.40$). Thus, the older adults in all three groups should have had similar requirements for communication in their everyday lives.

Extent of Use of Information and Communication Technologies

The extent of use of information and communication technologies was determined and compared to the national sample for the 13 technologies that were common to both the present study and the national survey (Statistics Canada, 2000). As shown in Figure 3, the study sample used all of the technologies to a much greater extent, often three or four times more, than those in the national sample. The only technologies used by a majority of the national sample were radio and cable television, whereas the majority of our sample used all of the technologies except satellite television receivers and pagers.

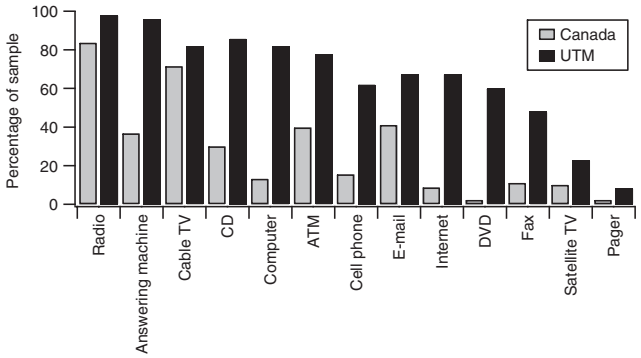

Figure 3: Percentage of older adults in the present sample and in a national sample who used various technologies to any extent

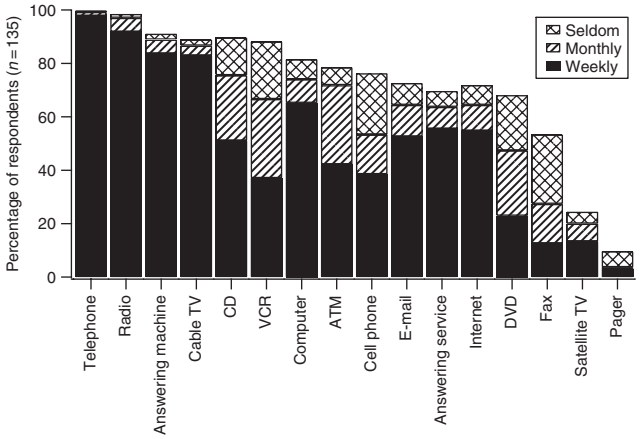

Figure 4: Extent of use of various technologies by respondents (excluding those who responded "never")

Figure 4 shows the extent to which the seniors in the present sample used various communication and information technologies. Extent of use was categorized as *weekly*, *monthly*, *seldom*, or *never*. The first three categories are plotted and the height of the stacked histograms indicates the percentage of participants who used each technology to any extent. Not surprisingly, the technologies used most regularly, at least weekly, were older technologies, including telephone and telephone answering machines, radio, and cable television. It is interesting that computers, along with the Internet and e-mail, were also among the next most regularly used technologies.

Figure 5 shows the percentage of seniors in our sample in the normal, corrected, and uncorrected hearing groups who reported using each of the 16 technologies to any extent. The 6 most frequently used technologies (telephone, radio, telephone answering machine, cable TV, CD, and VCR) were used by more than 80 per cent of those in each of the three groups, and 2 other technologies (cell phones and telephone answering service) were used by more than 60 per cent of those in each of the three groups. At the other extreme, the 2 least frequently used technologies (satellite TV receiver and pager) were used by less than 30 per cent of those in each of the three groups. However, 5 of the 16 technologies (Internet, e-mail, computer, fax, ATM) were used to markedly different extents by the three groups, with the percentage of those using these technologies being at least 20 per cent less for the uncorrected-hearing-loss group than

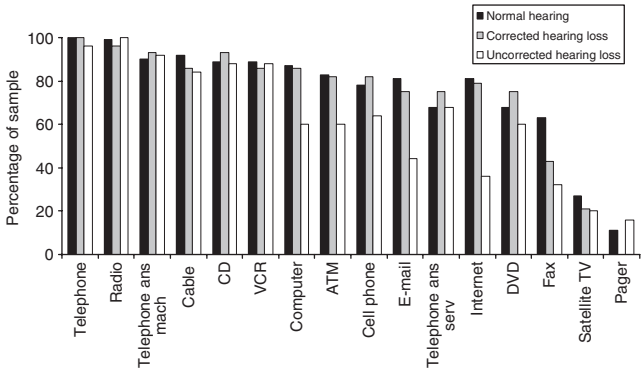

Figure 5: Percentage of older adults using various technologies to any extent for the three sub-groups—normal hearing, corrected hearing loss, and uncorrected hearing loss

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

for either of the other two groups. Significant relationships were found between group and the use of the 5 technologies: Internet ($\chi^2(2) = 19.537$, $p < 0.0005$); e-mail ($\chi^2(2) = 12.923$, $p < 0.002$); computer ($\chi^2(2) = 9.394$, $p < 0.009$); fax ($\chi^2(2) = 9.155$, $p < 0.01$); and ATM ($\chi^2(2) = 6.246$, $p < 0.04$). The relationship between group and Internet use and the relationship between group and e-mail use remained significant after the Bonferroni correction for 16 tests.

The relationships between the extent of use of the 16 technologies (four use categories—*weekly*, *monthly*, *seldom*, *never*) and demographic variables (age, first language, education, occupation, transportation) were also examined. Only education and occupation were related to the extent of use of any of the technologies. In general, those with more education tended to use the technologies more. Education was significantly related to the extent of use of three technologies: telephone answering services $\chi^2(24) = 37.4$, $p < 0.04$); fax ($\chi^2(24) = 40.7$, $p < 0.02$); and cable television ($\chi^2(24) = 40.8$, $p < 0.02$); however, these relationships were no longer significant after the Bonferroni correction was applied. Occupation was significantly related to the extent of use of telephone answering services ($\chi^2(18) = 39.5$, $p < 0.002$) and remained significant after the Bonferroni correction was applied for 16 tests. The most frequent users of telephone answering services were those who had been in professional or sales/service occupations.

Ability to Use Information and Communication Technologies

The ability of the present study sample to use technologies is illustrated in Figure 6. The majority rated their level of ability to be *excellent* for the most commonly used technologies (telephone and telephone answering machine, radio, and cable television), as well as for the less commonly used ATM. The majority rated their ability to be *very good* for the next most commonly used technologies (CD and VCR), as well as for the less commonly used telephone answering service. It is not surprising that the ability of older adults to use technologies is better for the types of technology that are the most commonly used. It may be that ability is also high for the less common ATM and telephone answering technologies because of the high importance of these technologies. Although fewer older adults used newer and more specialized technologies, such as satellite television and pagers, most of those who did use these technologies reported that their ability to use them was at least *good*. It may be that the least commonly used technologies are primarily used by those who are most willing and/or able to learn to use new or specialized technologies. Overall, very few older adults who reported using a technology reported that their ability to use it was *fair* or *poor*.

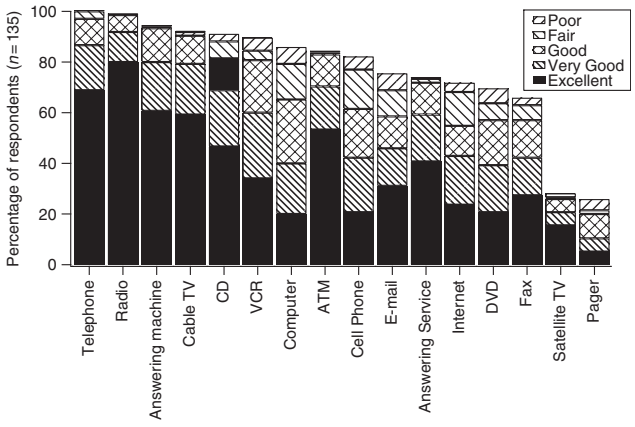

Figure 6: Ability of respondents (excluding responses of "don't know")

The relationships between ability to use each technology (five ability categories: *excellent*, *very good*, *good*, *fair*, *poor*) and extent of use (four use categories: *weekly*, *monthly*, *seldom*, *never*) were examined. Not surprisingly, the most common pattern was for more regular use of a technology to be associated with better ability to use it. A somewhat different pattern was found for computer, Internet, and e-mail, which were used regularly by participants reporting a wide range of abilities. A third pattern was observed for pager and fax, which were used by a small number of people, most of whom reported a high level of ability to use the technology but with a wide range in how regularly the technology was used. These relationships were tested for each of the technologies. With the Bonferroni correction applied, significant relationships were found for 15 of the 16 technologies, with the one exception being the telephone. The telephone is such a common and well-known technology that virtually everyone used it frequently and with excellent ability.

For those who used the various technologies to any extent, a relatively small percentage in each group reported that their ability to use the technology was only fair or poor (Figure 7). For half of the technologies, the group with corrected hearing loss was the group with the highest percentage reporting only fair or poor ability. For five other technologies, the group with uncorrected hearing loss was the group with the highest percentage reporting only fair or poor ability. Nevertheless, the differences between groups were not great. It is interesting that about half of those with corrected hearing loss used a hearing aid in combination with all the technologies that they used to any extent, and a higher percentage used the

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

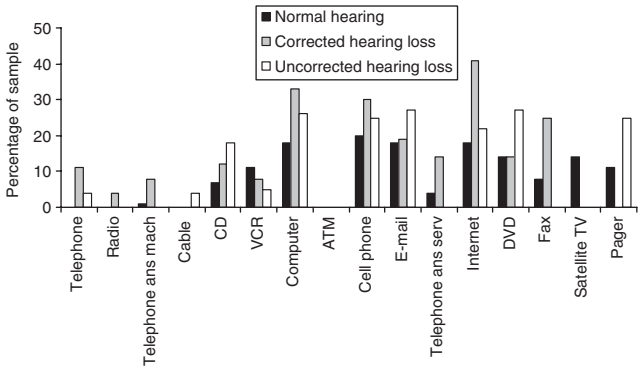

Figure 7: Percentage of older adults using various technologies to any extent who report fair or poor ability to use the technology for the three sub-groups—normal hearing, corrected hearing loss, and uncorrected hearing loss

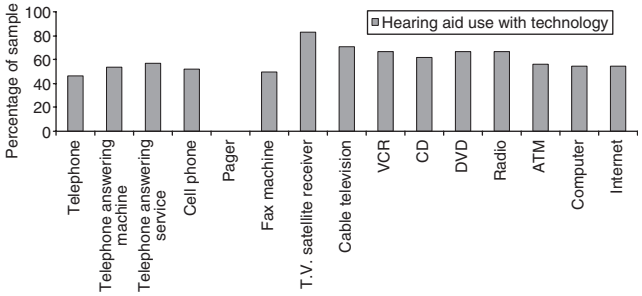

Figure 8: Percentage of those in the group with corrected hearing loss and using each technology who used the hearing aid in combination with the technology used

hearing aid with technologies such as television, CD, and DVD that involved a significant audio component (Figure 8). The only technology for which there was a significant relationship between group and ability was the telephone ($\chi^2(2) = 8.415$, $p < 0.015$), but the relationship was not significant after applying the Bonferroni correction. Curiously, telephone was the technology that was least often used in combination with a hearing aid by those in the group with corrected hearing loss. The relatively infrequent use of hearing aids for telephone communication may be explained by the use of telephone amplifiers or other assistive technologies designed to improve telephone communication for people who are hard of hearing. Another factor may be that there are a variety of ways in which conventional telephones can be coupled to a hearing aid and hearing-aid wearers may not be aware of the options available to them for combining hearing aid and telephone use.

The relationships between ability to use the 16 technologies and demographic variables (age, first language, education, occupation, transportation) were also examined. Nine relationships reached significance. In general, those who drive themselves report a higher level of ability to use technologies, perhaps because they are more independent and confident with technology than those who do not drive. Transportation was significantly related to ability to use 5 technologies: CD ($\chi^2(10) = 32.2$, $p < 0.0005$); radio ($\chi^2(8) = 22.8$, $p < 0.004$); telephone answering service ($\chi^2(10) = 22.5$, $p < 0.01$); cellular phone ($\chi^2(10) = 24.7$, $p < 0.02$); and satellite television ($\chi^2(10) = 19.7$, $p < 0.03$); however, only the relationship between transportation and ability to use CD technology remained significant after the Bonferroni correction was applied for 16 tests. Occupation was significantly related to ability to use two technologies: computer ($\chi^2(30) = 50.8$, $p < 0.01$), with those with professional, technology, and clerical occupations reporting higher levels of ability to use computers; and cable television ($\chi^2(24) = 36.6$, $p < 0.05$), with those with professional, clerical, and sales/service occupations reporting higher levels of ability to use cable television. However, neither of these relationships remained significant after the Bonferroni correction was applied. Education was also significantly related to ability to use a computer ($\chi^2(40) = 63.8$, $p < 0.01$), with those with more education reporting higher levels of ability to use a computer, but this relationship did not remain significant after the Bonferroni correction was applied. First language was significantly related to ability to use the radio ($\chi^2(4) = 11.2$, $p < 0.03$), with those whose first language was English reporting a higher level of ability to use the radio, but this relationship did not remain significant after the Bonferroni correction was applied.

Discussion

Overall, the seniors in the present sample, who were drawn from a pool of seniors who participated in university-based experimental studies of communication and aging, differed from an earlier national sample on demographic factors. Specifically, compared to the national sample (Statistics Canada, 2000), the study sample was more educated and included a higher percentage of people who had worked in "white collar" occupations, who drove their own car, and who spoke English as a first language. The study sample reported more vision and hearing problems than the national sample. Almost all of those in the study sample wore corrective lenses and, compared to the national sample, a higher percentage used hearing aids. Importantly, more of the study sample participated in communication-demanding leisure activities than the average Canadian senior and those in the

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

sample used technology to a greater extent than the average Canadian senior.

Even though the study sample participated in more communication-demanding leisure activities and used information and communication technologies more than the general national sample, for both samples, the pattern of usage of technologies was similar. In addition, the extent of use and the ability to use technology in both samples was influenced by demographic factors such as education, occupation, method of transportation, and language. Similar to the finding regarding computer use in the national sample, for all of the technologies investigated in the present study, a greater extent of technology use was positively related to a better level of ability to use technology. Therefore, those who participate in laboratory studies seem to be more active in leisure activities and may be earlier adopters of technology, but their pattern of participation in communication-demanding activities of daily living also seems to have much in common with that of the general population of older communicators.

Overall, the seniors in our sample who had better sensory abilities used technologies slightly more than those with sensory loss, especially in the case of newer and more specialized technologies. They also had better ability to use some technologies. These patterns of extent of use and ability to use technology are consistent with the earlier national findings that Canadian seniors are more likely to use technologies (e.g., the Internet, computer, telephone answering machine, pager, and cable television) if they have never had difficulty hearing, seeing, or communicating. Moreover, Canadian seniors are more likely to use cell phones to a greater extent and to have better ability to use a computer if they have never had sensory difficulties (Statistics Canada, 2000).

The most striking finding of the present study is that the extent of use of information and communication technologies, in particular the Internet and e-mail, was less for those with uncorrected hearing loss than for those with good hearing but that there was no difference between the sub-group with good hearing and the sub-group with hearing loss corrected by the use of hearing aids. Even though those who had a hearing aid used information and communication technologies to a greater extent than those with uncorrected hearing loss, they more often reported only fair or poor ability to use a number of technologies, most notably the telephone. Indeed, using a hearing aid may have enabled those with hearing difficulties to maintain the same extent of use of other technologies as those with normal hearing, even if they had more difficulty achieving the same ability level as those who did not use assistive technology.

Compared to the national population, a higher percentage of the study sample had hearing loss and used hearing aids (Statistics Canada, 2002). The percentage of older adults in our sample who had a hearing aid (20.7%) was more than twice that found in the Canada-wide survey (7.4%). Note that, because the national survey was conducted over the telephone, it is possible that the participation of those with hearing loss may have been reduced. However, the percentage of those in our sample with hearing loss who had a hearing aid (53.9%) was also more than twice the figure (20%) that has typically been reported in large-scale market surveys in the United States (Kochkin, 1993). Some of the difference in the percentage of seniors with hearing loss may be explained by the fact that objective measures of hearing were available for the study sample, whereas only subjective measures were gathered for the national sample, and estimates based on self-report measures are often lower than those based on clinical measures, especially in seniors (Erdman & Demorest, 1998). The discrepancy between self-identification or disclosure of hearing loss and objective test results is consistent with the common finding that diagnosis and professional help may not be sought for as long as 20 years after a person first becomes aware of hearing difficulties (Getty & Hétu, 1994; Hétu, 1996; Kyle, Jones, & Wood, 1985; van den Brink, Wit, Kempen, & van Heuvelen, 1996). Conversely, the audiogram is a simple test of hearing ability that may not predict the ability of a listener to function in everyday life, especially in complex communication situations (Pichora-Fuller & Carson, 2000). Thus, physical damage to the auditory system may already have taken place before someone identifies and discloses that they are having hearing problems and even before changes in audiometric thresholds are measurable. Whether or not hearing loss was actually more common in our sample, it seems to be clear that our sample of older adults included more individuals who had taken action to solve hearing-related problems. It should not be surprising that, compared to seniors in the general population, those who volunteer to participate in experiments may be earlier adopters of all types of technology, including assistive technology.

Taken together, the findings of the present study suggest that most community-living seniors do have functional needs for communication during a wide range of leisure activities. Ongoing participation in communication activities of daily living may motivate or eventually require them to adapt to newer technologies such as the Internet. Most older adults,

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

whether or not they have hearing impairment, are able to keep pace with rapid developments in information and communication technology; for example, at least once a week, over 65 per cent of the study sample used the Internet and over 40 per cent used an ATM. Interestingly, there seems to be a connection between use of general communication and information technologies and the use of hearing aids.

Implications for Future Research

Generalizing from the present findings to a broader population requires appropriate cautions. The questionnaire was designed to be similar to the national surveys in order to facilitate comparisons between the present and earlier national samples. The study sample used communication technologies to a greater extent and with better abilities than those who participated in the national surveys. There were also demographic differences between the participants in the studies. Importantly, there was an interval of 6 years between the time of collection of the national data in 2000 and the study data collected in 2006. This interval between studies introduces the possibility that the differences could be attributable, at least partially, to widespread societal changes over time rather than to other differences between the samples. On average, the study sample can be considered to have been more advantaged than the national sample in terms of educational, occupational, and language history. In addition, the study sample was atypical insofar as the volunteers self-selected to participate in university-based research on aging and communication. Perhaps those who volunteer for research on communication and aging are more aware of communication or health issues in general, either because they rely heavily on communication in their daily activities or because they have problems with communication. It may also be that those who are more able or willing to recognize problems with communication and to take action to solve these problems are more likely to volunteer to participate in research on this topic. Thus, in relating the present findings to prior surveys of the national population, it is important to appreciate that the present findings may reflect a later stage of adoption as technological change has spread through Canadian society and/or it may reflect the situation of a sub-set of the population who tend to be earlier adopters of technologies. Longitudinal studies of technology use by older adults would clarify how these patterns differ over time and between different sub-sets of the general population.

In light of the present study, those attending hearing-aid evaluation appointments are an obvious sub-set of the population in which the connection between the use of general and assistive technology should be explored more intensively. Specifically, such a study could test the hypothesis that those who use general communication and information technologies to a greater extent are more likely to comply with the recommendation that they obtain a hearing aid, more likely to purchase the aid at the end of the trial period, and more likely to continue using it after purchase. If the hypothesis is supported, then those who use general communication and information technologies to a lesser extent may be easily identified as being at risk for non-compliance. Specific rehabilitative training programs, modelled on those used to facilitate the adoption of other kinds of new technologies by seniors (Czaja et al., 2006) could then be offered to those who are at risk.

Seniors with vision loss, including those with uncorrected vision impairments and those with dual-sensory losses, are another sub-set of the population that could be examined more closely. In future studies, objective measures of vision should be included. Most of the participants in the present study wore corrective lenses and none reported any difficulty reading the questionnaire (see note 1 at the end of this article). However, alternative formats—including the use of larger fonts and modifications to the layout to group response options in a more obvious fashion—would be required to make the study accessible to those with such uncorrected vision impairments as are commonly found in older people. Improved instructions could also be used to avoid the possibility that some participants may have responded to the questions about ability to use technology as if the question meant ability to hear/see with technology. Additional questions could also be included to determine if the respondents owned technologies and whether they used technologies at home and/or in public locations. Specific questions about income and the importance of the cost of devices would also provide valuable information that might explain differences among sub-groups.

Implications for Practice

Today, health care for people with disabilities is very different from in the early twentieth century. The findings of the present study point to two areas of health and professional practice that could enhance the use of information and communication technologies by seniors. One area is health promotion and educational programs related to healthy communication. The other is the extension of the concept of universal design to information and communication technologies.

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

The World Health Organization *International Classification of Functioning, Disability, and Health* (2001) provides a useful framework through which health issues can be related to functioning in everyday life. Whereas health was previously thought of as the absence of disease, this more recent framework focuses on health issues, such as aging, without focusing on disease(s), and it acknowledges that functioning in everyday life may be altered by changes in the body (impairments), limitation in specific activities (e.g., reading or listening to speech), and/or restrictions on participation in social roles (e.g., functioning effectively as a family member or worker or citizen). Importantly, the individual's physical and social environments are assumed to modulate how s/he functions, so that someone with no impairment may function poorly in an adverse environment, whereas someone else with an impairment may function well in a supportive environment. This framework is highly compatible with a health-promotion outlook that seeks to create supportive conditions that enable people to maintain functioning or wellness and seeks to prevent health-related problems from occurring rather than waiting to treat health problems once they have already begun to have a negative effect on functioning. Health-promotion programs aimed at communication wellness in older adults have been successfully implemented (Hickson, Worrall, Yiu, and Barnett, 1996; Worrall, Hickson, Barnett, & Yiu, 1998). Such programs aim to educate well seniors who do not necessarily have vision, hearing, speech, or language problems, about how to maintain good communication abilities, how to identify communication problems early, and how to formulate strategies for help seeking and action taking in the event that communication problems do arise in the future. It would be natural to include information and discussion about general information and communication technologies along with the information that is provided about specialized assistive technologies that may be of interest to those who develop communication disorders. Education about these technologies should be compatible with the thrust of a program to educate healthy older adults so that they can maintain healthy communication. Importantly, such programs should be community-based rather than being clinic-based and they should not target only those with a known impairment.

Another area of practice related to the use of information and communication technologies by seniors is universal design to accommodate those who have known sensory or communication impairments. In general, people with disabilities have gone from being an excluded minority group to being an important segment of society, whose contributions are valued. During the latter part of the twentieth century, various steps were taken to include people with disabilities in mainstream society and to provide equal opportunities among individuals. To these ends, the barrier-free movement started, and legislation, such as the Americans with Disabilities Act, was passed (Mueller & Mace, 1998). Universal design is an emerging field that aims to make environments or products accessible to everyone, regardless of ability, at little or no extra cost (Mueller & Mace, 1998). Again, rather than focusing on specialized assistive technology, the goal is for the needs of those with impairments to be solved using the same technologies as those that are used by all members of society (e.g., a fax machine or e-mail being used by a person whose hearing loss makes it difficult to use a telephone).

The results of the present study indicate that sensory abilities are related to seniors' use of many more general communication and information technologies. Moreover, seniors with better technological abilities are more likely to use technologies to a greater extent. If one designs communication education programs and technologies for all seniors, regardless of their abilities, then differences in the population's ability to use and extent of use of technology may be reduced.

Note

1 To obtain a copy of the questionnaire, please contact the corresponding author.

References

Appolonio, I., Carabellese, C., Frattola, L., & Trabucchi, M. (1996). Effects of sensory aids on the quality of life and mortality of elderly people: A multivariate analysis. *Age and Aging*, *25*, 89–96.

Cacciatore, F., Napoli, C., Abete, P., Marciano, E., Triassi, M., & Rengo, F. (1999). Quality of life determinants and hearing function in an elderly population: Osservatorio Geriatrico Campano study group. *Gerontology, 45*, 323–328.

Czaja, S.J., Charness, N., Fisk, A.D., Hertzog, C., Nair, S.N., Rogers, W.A., et al. (2006). Factors predicting the use of technology: Findings from the centre for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging*, *21*, 333–352.

Davis, A. (1995). *Hearing in adults*. London: Whurr.

Erber, N.P., & Heine, C. (1996). Screening receptive communication of older adults in residential care. *American Journal of Audiology, 5*, 38–46.

Erdman, S.A., & Demorest, M.E. (1998). Adjustment to hearing impairment 1: Description of a heterogeneous

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

clinical population. *Journal of Speech, Language, and Hearing Research*, *41*, 107–122.

Gates, G.A., Cooper, J.C., Kannel, W.B., & Miller, N.J. (1990). Hearing in the elderly: The Framingham cohort 1983–1985, Part I: Basic audiometric test results. *Ear and Hearing*, *11*, 247–256.

Getty, L., & Hétu, R. (1994). Is there a culture of hard-of-hearing workers? *Journal of Speech-Language Pathology and Audiology*, *18*, 267–270.

Gibson, J.M., Lavery, J.R., & Rosenthal, A.R. (1986). Blindness and partial sight in an elderly population. *British Journal of Opthalmology*, *70*, 700–705.

Gillman, A.E., Simmel, A., & Simon, E.P. (1986). Visual handicap in the aged: Self-reported visual disability and the quality of life of residents of public housing for the elderly. *Journal of Visual Impairment and Blindness*, *80*, 588–590.

Hanley, P. (2002). *The Numbers Game: Older People and the Media*. London: Independent Television Commission.

Hétu, R. (1996). The stigma attached to hearing impairment. *Scandinavian Audiology*, *43*(Suppl.), 12–24.

Hickson, L., Worrall, L., Yiu, E., & Barnett, H. (1996). Planning a communication education program for older people. *Educational Gerontology*, *22*, 257–269.

Hummert, M.L., & Nussbaum, J. (Eds.). (2000). *Communication, aging, and health: Linking research and practice for successful aging*. New York: Lawrence Erlbaum.

Kochkin, S. (1993). MarkeTrak III: Why 20 million in the U.S. don't use hearing aids for their hearing loss. *Hearing Journal*, *46*, 28–31.

Kyle, J.G., Jones, L.G., & Wood, P.L. (1985). Adjustment to acquired hearing loss: A working model. In H. Orland (Ed.), *Adjustment to adult hearing loss* (pp. 119–138). San Diego, CA: College-Hill Press.

Laforge, R.G., Spector, W.D., & Sternberg, J. (1992). The relationship of vision and hearing impairment to one-year mortality and functional decline. *Journal of Ageing and Health*, *4*, 126–148.

Lubinski, R., & Higginbotham, D.J. (1997). *Communication technologies for the elderly: Vision, hearing, and speech*. London: Singular.

Madden, G., & Savage, S. (2000). Some economic and social aspects of residential Internet use in Australia. *Journal of Media Economics*, *13*(3), 171–185.

Marsiske, M., Klumb, P., & Baltes, M.M. (1997). Everyday activity patterns and sensory functioning in old age. *Psychology and Aging*, *12*, 444–457.

McLuhan, M., & Fiore, Q. (1968). *War and peace in the global village*. New York: Bantam.

Mencher, G., Gerber, S., & McCombe, A. (1997). *Audiology and auditory dysfunction*. Needham Heights, MA: Allyn & Bacon.

Mueller, J.L., & Mace, R.L. (1998). A brief history of universal design. In M.F. Story, J.L. Mueller, & R. Mace (Eds.), *The universal design file: Designing for people of all ages and abilities* (pp. 5–14). Raleigh, NC: North Carolina State University, Centre for Universal Design.

Mulrow, C.D., Tuley, M.R., & Aguilar, C. (1992). Sustained benefits of hearing aids. *Journal of Speech and Hearing Research*, *35*, 1402–1405.

Naramura, H., Nakanishi, N., Tatara, K., Ishiyama, M., Shiraishi, H., & Yamamoto, A. (1999). Physical and mental correlates for hearing impairment in the elderly in Japan. *Audiology*, *38*, 24–29.

Pichora-Fuller, M.K., & Carson, A.J. (2000). Hearing health and the listening experiences of older communicators. In M.L. Hummert, & J. Nussbaum (Eds.), *Communication, aging, and health: Linking research and practice for successful aging* (pp. 43–74). New York: Lawrence Erlbaum.

Scherer, M.J., & Frisina, R. (1998). Characteristics associated with marginal hearing loss and subjective well-being among a sample of older adults. *Journal of Rehabilitation Research Development*, *35*, 420–426.

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

Seniors Research Group. (1999). *The consequences of untreated hearing loss in older persons*. Washington, DC: National Council on Aging.

Statistics Canada. *General social survey on time use, cycle 12: Leisure activities* [Computer file]. (1998). Ottawa: Author. Retrieved 20 Jan. 2006 from http://r1.chass.utoronto.ca/sdaweb/html/gss.htm.

Statistics Canada. *General social survey on access to and use of information communications technology, cycle 14* [computer file]. (2000). Rev. ed. Ottawa: Author. Retrieved 20 Jan. 2006 from http://r1.chass.utoronto.ca/sdaweb/html/gss.htm.

Statistics Canada. *General social survey on social support and ageing, cycle 16* [Computer file]. (2002). Ottawa: Author. Retrieved 20 Jan. 2006 from http://r1.chass.utoronto.ca/sdaweb/html/gss.htm.

Teo, T. (2001). Demographic and motivation variables associated with Internet usage activities. *Internet Research-Electronic Networking Applications and Policy*, *11*(2), 125–137.

van den Brink, R.H.S., Wit, H.P., Kempen, G.I.J.M., & van Heuvelen, M.J.G. (1996). Attitude and help-seeking

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press

for hearing impairment. *British Journal of Audiology, 30*, 313–324.

World Health Organization. (2001). *International Classification of Functioning, Disability and Health (ICF)*. Geneva: WHO. Retrieved 20 May 2008 from http://www.who.int/classifications/icf/en/.

Wormald, R.P.L., Wright, L.A., Courtney, P., Beaumont, B., & Haines, A.P. (1992). Visual problems in the elderly population and implications for services. *British Medical Journal*, *304*, 1226–1229.

Worrall, L., Hickson, L., Barnett, H., & Yiu, E. (1998). An evaluation of the *Keep on Talking* program for maintaining communication skills into old age. *Educational Gerontology, 24*(2), 129–140.

https://doi.org/10.3138/cja.27.2.145 Published online by Cambridge University Press