journal homepage: www.ijmijournal.com

Older adults: Are they ready to adopt health-related ICT?

Tsipi Heart, Efrat Kalderon*

Department of Industrial Engineering & Management, Ben-Gurion University of the Negev, Israel

ARTICLE INFO

Article history:
Received 4 March 2010
Received in revised form
16 August 2010
Accepted 10 March 2011

Keywords:
Older adults
Technology and ICT use
Healthcare ICT

ABSTRACT

Background: The proportion of older adults in the population is steadily increasing, causing healthcare costs to rise dramatically. This situation calls for the implementation of health-related information and communication technologies (ICT) to assist in providing more cost-effective healthcare to the elderly. In order for such a measure to succeed, older adults must be prepared to adopt these technologies. Prior research shows, however, that this population lags behind in ICT adoption, although some believe that this is a temporary phenomenon that will soon change.
Objectives: To assess use by older adults of technology in general and ICT in particular, in order to evaluate their readiness to adopt health-related ICT.
Method: We employed the questionnaire used by Selwyn et al. in 2000 in the UK, as well as a survey instrument used by Morris and Venkatesh, to examine the validity of the theory of planned behavior (TPB) in the context of computer use by older employees. 123 respondents answered the questions via face-to-face interviews, 63 from the US and 60 from Israel. SPSS 17.0 was used for the data analysis.
Results: The results show that although there has been some increase in adoption of modern technologies, including ICT, most of the barriers found by Selwyn et al. are still valid. ICT use was determined by accessibility of computers and support and by age, marital status, education, and health. Health, however, was found to moderate the effect of age, healthier older people being far more likely to use computers than their unhealthy coevals. The TPB was only partially supported, since only perceived behavioral control (PBC) emerged as significantly affecting intention to use a computer, while age, contrary to the findings of Morris and Venkatesh, interacted differently for Americans and Israelis. The main reason for non-use was 'no interest' or 'no need', similar to findings from data collected in 2000.
Conclusions: Adoption of technology by older adults is still limited, though it has increased as compared with results of the previous study. Modern technologies have been adopted (albeit selectively) by older users, who were presumably strongly motivated by perceived usefulness. Particularly worrying are the effects of health, PBC, and the fact that many older adults do not share the perception that ICT can significantly improve their quality of life. We therefore maintain that older adults are not yet ready to adopt health-related ICT. Health-related ICT for the elderly should be kept simple and demonstrate substantial benefits, and special attention should be paid to training and support and to specific personal and cultural characteristics. These are mandatory conditions for adoption by potential unhealthy and older consumers.

* Corresponding author at: Ben-Gurion University of the Negev, Industrial Engineering & Management, POB 653, 84105 Beer-Sheva, Israel. Tel.: +972 8 6472255.
E-mail address: heart@bgu.ac.il (T. Heart).
1386-5056/$ – see front matter © 2011 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.ijmedinf.2011.03.002

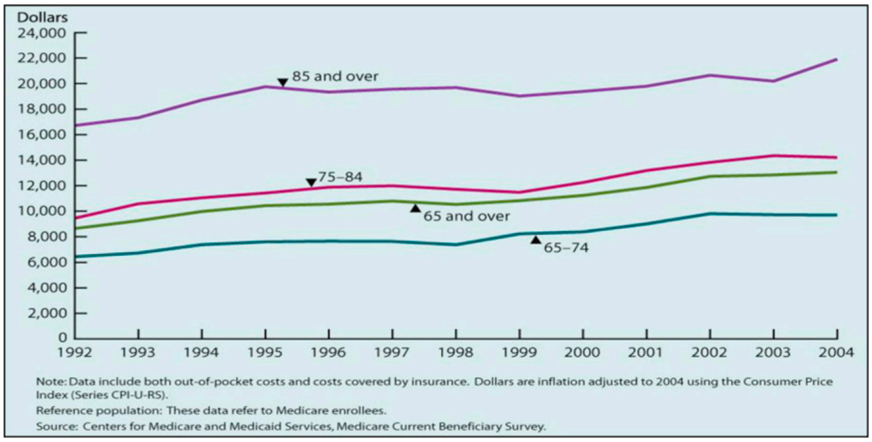

Fig. 1 – Average annual health care costs for Medicare enrollees aged 65 and over.

Source: http://www.agingstats.gov/Agingstatsdotnet/Main_Site/default.aspx.

1. Introduction

With the dramatic increase of people with chronic conditions and an ageing population there is a need to extend care from the hospital to the home. GE Healthcare and Intel are helping to address these pressing issues. The market for telehealth and home health monitoring is predicted to grow from US$ 3 billion in 2009 to an estimated US$ 7.7 billion by 2012 [1]. This quote relates to just one of many ICT-driven endeavors recently initiated all over the developed world to enhance healthcare provided for elderly people. It has been suggested that the use of information and communication technologies (ICT) such as computerized devices, home computers, Internet, and other communication devices could significantly improve the quality of life of elderly people, as well as facilitate cost-effective care by formal and informal care providers [2]. This is particularly desirable in light of the expected growth in the percentage of people 65 and over in the population and in the average annual cost of health care for this cohort (Fig. 1).

For such technologies to be efficient and effective, elderly people must be willing and able to use them. Prior research has indicated that age is negatively related to use of ICT, for such reasons as age-related changes and decline of sensory and cognitive abilities [3], as well as difficulty in obtaining technical support [4–9]. It is suggested that these barriers, among others, explain the imparity in adoption of modern technologies [3], for example personal computer (PC) use and Internet access, where senior people are under-represented, as evident in Table 1.

Although the data in Table 1 relate to the US adult population [10], similar numbers have been reported in other developed countries [11]. The picture that emerges casts doubt on the prospects for successful adoption of healthcare-related ICT among older people. It is therefore imperative to investigate the patterns of ICT use by this group in order to determine what needs to be done to ensure effective implementation, adoption and use.

Although there is a consensus among researchers as to the effect of age on ICT use, some maintain that this is a temporary situation that will significantly change within a few years as the older generation acquires experience in using ICT. However, technological innovations such as the multi-touch user interface used in the iPhone and other devices, or more recently the motion-activated user interface, are being introduced at a fast pace. These innovations significantly change the way people interact with ICT. Is it likely that future generations of older people will adopt technological innovations more readily than the present generation? If indeed impairments inherent to older age are major barriers to adoption, then it is quite likely that the present difficulties will persist into the future as well.

In order to investigate changes in technology use patterns in general and ICT use in particular, the present study replicated the data collection work of Selwyn and collaborators [12] in the UK in 2000. The following questions were addressed: (1) Does age still affect ICT use among older adults? (2) What access do older adults have to ICT? Where can older adults access ICTs? What access do older adults have to ICT support? How does access to 'new' ICTs such as computers and the Internet compare with access to other technologies? (3) What factors are associated with older adults' access to ICT (e.g. gender, age, educational background, health conditions, marital status)? (4) What are older adults using ICT for? (5) What are the reasons behind older adults' non-use of ICT?

Data for this study were collected in 2007–2008 from 63 elderly people in the US and 60 in Israel. Our findings corroborated those of Selwyn et al., although the proportion of older adults using ICT was higher. Similar to the earlier results, most non-users indicated that lack of need for ICT was the primary reason for not using a computer, suggesting that not much had changed in the years that elapsed since the earlier study. Age was still found to significantly and negatively affect use, with health emerging as a moderating factor that augments the effect of age. This evidence is worrying in light of the intensive effort being invested in introducing technologies to improve the quality of life of older people. The implications of these findings will be discussed further on.

The rest of the paper is organized as follows: literature survey, description of the methods employed, and results. The paper concludes with a discussion and presentation of conclusions.

Table 1 – Internet use by age [10].

Years Born	Ages in 2009	% of total adult population	% of Internet using population
1977–1990	18–32	26%	30%
1965–1976	33–44	20%	23%
1955–1964	45–54	20%	22%
1946–1954	55–63	13%	13%
1937–1945	64–72	9%	7%
>1936	>73	9%	4%

Pew Internet & American Life Project December 2008 survey.

N = 2253 total adults, and margin of error is ±2%. N = 1650 total Internet users, and margin of error is ±3%.

1.1. *Literature survey*

The most rapidly growing segment of the population in developed countries consists of the elderly, particularly the 'oldest old' aged 80 plus. For example, the UK Office for National Statistics found that over the last 25 years the percentage of the population aged 65 and over increased from 15% in 1983 to 16% in 2008, an increase of 1.5 million people. Over the same period, the percentage of the population aged 16 and under decreased from 21% to 19%. This trend is projected to continue so that by 2033, 23% of the population will be aged 65 and over versus 18% aged 16 or younger [13]. Similar figures are being reported all over the developed world. Given this demographic forecast, there is a clear and urgent need to provide more effective and efficient healthcare while reducing the number of care providers. Information and communication technologies are seen as the key to achieving these goals [14], yet recent studies showed that acceptance and adoption of ICT by the elderly is problematic [15,16], and particularly so in the healthcare context [2,17–19]. This evidence is troubling in light of the extensive investments by governments and institutions in the development of applications and devices to improve healthcare for older people [2], the success of which largely depends on adoption and use by the elderly consumers. Indeed, as reported in a review by Marschollek et al. [2], most such projects failed for various reasons, prominent among which was consumer reluctance.

Studies investigating older ICT users found that many of the restrictions and social isolation problems that elderly people face on a daily basis could be alleviated through the use of computers and online technologies [6,15]. Indeed, older people who used computers thought they enjoyed better social interaction, memory enhancement, and mental stimulation. It is claimed that using the Internet can improve the quality of life of ageing people by inducing them to learn new technologies and thus maintain their cognitive capabilities and self esteem, as well as by opening new avenues to information and services that would otherwise be difficult to access [6].

1.2. *ICT applications in healthcare*

In 1995, former U.S. Surgeon General C. Everett Koop stated: "...cutting-edge technology, especially in communication and information transfer, will enable the greatest advances yet in public health. Real health care reform will come only from demand reduction, as individuals learn to take charge of their health. Communication technology can work wonders for us in this vital endeavor. Eventually, personal home telemedicine links could provide every home with access to health information 24 h a day, 7 days a week, encouraging personal wellness and prevention, and leading to better informed decisions about health care" [20, p. 760]. Indeed, fifteen years later, the dominant use of ICT in healthcare is in conveying high-quality health information and educative materials to consumer patients, in order to empower them to make informed decisions and deal more actively with their health [2,21]. Some of the relevant websites focus on specific diseases [22–24], whereas others are general portals such as MedlinePlus [25]. A notable application is NIHSeniorHealth (www.nihseniorhealth.org), which is especially designed for older users. While the number of accesses to these applications has been growing, a study of a German portal revealed that older consumers aged >65 comprised only 2% of users, with younger surfers, possibly relatives and caregivers, constituting the vast majority of users [2].

Telemedicine and pervasive and ubiquitous computerized services have mainly been used for monitoring and communication purposes to facilitate remote care for people at home; all report limited success in terms of adoption and use [14,26–33], with reasons cited for non-use ranging from excessively complex to offering no advantage over more traditional alternative solutions.

1.3. *Theories explaining ICT adoption*

One of the fundamental theories that seek to explain particular behaviors is the theory of planned behavior (TPB) [34], which posits that a behavior is the result of an intention to carry it out, which is in turn influenced by attitude (ATT) toward the behavior, perceived behavioral control (PBC), and subjective norm (SN). PBC "reflects perceptions of internal and external constraints on behavior and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions" [35, p. 454], while SN is defined as "The person's perception that most people who are important to him think he should or should not perform the behavior in question" [35, p. 452]. Drawing upon the TPB, the technology acceptance model (TAM) [36] has been developed to explain ICT use. According to TAM, perceived usefulness (PU) and perceived ease of use (PEOU) are the primary determinants affecting attitude toward use, which affects intention to use. Additionally, PU, which is impacted by PEOU, was found to directly affect intention to use. Later research developed TAM2 [37], which included antecedents to PU and PEOU, and the unified theory of acceptance and use of technology (UTAUT), which posited that four categories of variables influence information technology acceptance: performance expectancy, effort expectancy, facilitating conditions, and social influence [35]. Several researchers have adapted the above frameworks to describe adoption of ICT by older adults [11,19,27,38–41].

2. Determinants affecting ICT use in healthcare

A large number of determinants have been posited to affect ICT use in the healthcare context. The reader is referred to a systematic review of patient acceptance of consumer health information technology (CHIT) by Or and Karsh [42] which lists 94 determinants, of which 67 are patient-related factors associated with patient health (37 factors), socio-demographic variables, and variables relating to the individual's prior experience with computers. The remaining factors relate to human–computer interaction (HCI) and organizational/environmental factors, such as satisfaction with the health package provided. HCI factors include PU, PEOU, Internet dependence, self-efficacy toward computers, computer anxiety or fear of technology, intrinsic motivation, perceived information reliability, and some others. Age was the most frequently used factor, yet did not show a consistent effect. In contrast, other studies showed that, relative to younger adults, older adults reported less comfort, lower efficacy, and less control over computing technologies [16,43], perceptions that are likely to decrease acceptance [8,12,44].

While gender, the second most studied variable in the above review, demonstrated no effect in the majority of studies, higher education was positively associated with acceptance in 68% of the studies, as was prior experience or exposure [42].

The role of patient health status in CHIT acceptance also yielded mixed results, as some researchers showed that people experiencing poorer health conditions were more likely to accept CHIT [45,46], whereas others e.g. [47] showed that better health (less severely ill patients) was associated with increased acceptance. Having school age children at home was also found to drive acceptance, possibly via determinants such as social influence, support availability, and computer anxiety [42]. These findings were further corroborated by studies of specific health IT applications [17,26,41].

2.1. *ICT use by elderly people*

Extensive research has focused on ICT use by elderly people in general [6,7,11,12,18,19,38–40,43,44] and in the healthcare context in particular [2,14,24,27,32,48–52]. Morris and Venkatesh [43], for instance, found that age moderated the effects of attitude, PBC, and subjective norm on ICT use in the workplace, with the result that among older users use intention was less affected by attitude than among younger employees, and more affected by opinions of important persons and by perceived control; but it is important to note that the authors studied users at the workplace, where 'older' users are not very old. In contrast, the review of 52 articles devoted to CHIT adoption [42] showed mixed results regarding the association between age and technology acceptance. However, sufficient evidence supports the negative association between age and use of PC and Internet [12]. Declining physical and cognitive capabilities may cause seniors to experience greater difficulties in using computers, and these may serve as internal controls or may inhibit conditions that increase effort expectancy associated with IT use [53]. Czaja et al. [16] found that adults over 65 years of age had fewer computer skills and had less computer self-efficacy than younger adults, possibly leading to reduced use or intention to use computer technology; these older users, however, were willing to attempt training and ready to use ICT when sufficient instructions on use of the technology were provided [11,54]. Table 2 summarizes determinants affecting ICT use by elderly people in the healthcare context.

While designing easy-to-use systems adapted to specific impairments typical of older age is clearly recommended, researchers found that older users tended to focus on benefits more than on costs [3,12] and were willing to make the effort to acquire skills if they were convinced of the technology's advantages and adequacy for their specific needs, above and beyond traditional healthcare related means [16,55]. This evidence somewhat contradicts the common assertion that limited use of technology by older adults stems from low self-efficacy, computer anxiety, lack of accessibility, or technophobia—a negative attitude toward modern technology in general [7,8].

3. Research method

This study attempts to answer the research questions outlined above by replicating Selwyn et al.'s 2003 study [12] and by applying the TPB to a sample of older adults in their natural residence setting (private or nursing home, when nursing homes were the respondents' permanent residence).

3.1. *Sample*

Due to the difficulty of accessing respondents, no statistical sampling method was applied. Rather, a sample of convenience was used. Although this can be considered a limitation, the distribution of the sample in terms of personal characteristics was sufficiently representative of this population in terms of gender (i.e. a higher percentage of females, as is typical for this age group), education level, marital status, and health status, as can be seen in Table 3.

Data were collected from elderly people in Texas, USA, and in Israel. In the USA four nursing homes were visited, and residents who were available in public areas were approached for an interview; 63 residents agreed to participate. In Israel we interviewed 17 persons in two nursing homes and 43 persons living in their private homes. All the interviews were carried out in 2007 and 2008 and lasted 40 min to 1 h each.

Table 2 – Determinants of older users' acceptance of ICT.

Determinant	Description	References
Perceived usefulness, perceived impact, relevance	The degree to which the potential user perceives the technology as beneficial, useful, and able to significantly contribute to the purpose it is intended for	[3,6,12,19,27,39,41,55]
Perceived ease of use	The degree to which an individual perceives using the technology as free of effort	[2,39,41,48]
Issues associated with the technology	Factors such as the system's cost, complexity, and safety	[2,12,19,27]
Personal traits	Factors such as the individual's age, health condition, self-actualization, self-efficacy, prior experience with computers, computer anxiety	[4,11,19,41]
Social issues	Factors related to the social reference groups of the individual, such as subjective norm and image	[39,40,43]
Facilitating issues	Factors related to the external environment, such as availability of support	[27,39,48,54]

Table 3 – Descriptive statistics for the US and Israeli samples.

Parameter	U.S.A	Israel	Total	Mean	S.D.
Respondents	63 (51%)	60 (49%)	123		
Gender					
Female	70%	67%	68%		
Male	30%	33%	32%		
Age					
60–69	13%	17%	15%		
70–79	27%	38%	33%		
80–89	41%	33%	37%		
90+	19%	12%	15%		
Total	100%	100%	100%	80.2	8.58
Residence:					
Private home	0%	72%	35%		
Nursing home	100%	28%	65%		
Education					
Elementary	0%	25%	15%		
Junior High	6%	17%	11%		
High School	48%	47%	47%		
Bachelor	30%	10%	20%		
Master	10%	2%	6%		
Ph.D.	6%	0%	3%		
Total	100%	100%	100%	12.55	1.99
Mean	14.93	10			
S.D.	2.46	1.91			
Living with a partner:					
No	84%	45%	65%		
Yes	16%	55%	35%		
Severe Health Problems:					
No	17%	25%	20%		
Yes	83%	75%	79%		

3.2. *The research instrument*

We used Selwyn et al.'s questionnaire, which is composed of five sections[1]:

1. Statements related to accessibility to and use of various technologies.
2. Statements related to reasons for not using a computer, for persons stating they have not used computers in the last 12 months.
3. Statements related to use of computers, for persons stating they have used computers in the last 12 months.
4. Statements measuring the TPB model: ATT, PBC, and SN, adapted from Morris and Venkatesh [43] (Appendix A).
5. Personal questions relating to age, education, computer experience, health status, marital status, etc.

The questionnaire included 180 questions, with nominal or ordinal scales used for all but the demographic questions. A nominal scale was used to code values such as places of accessibility, perceptions, or frequency of use. An ordinal 4-point Likert scale (1—strongly disagree to 4—strongly agree) was used for statements with ascending scales to simplify the data collection process in view of the relatively advanced age of the responding population. Data were analyzed using SPSS 17.0.

[1] We refrained from attaching the questionnaire due to its length, but it can be secured from the first author.

Table 4 – Access to technologies by location.

	Own/Access at home (%)	No home access but access from family/friends (%)	Access elsewhere (%)	No access (%)
Computers and Peripherals				
Laptop	9	30	2	59
Palmtop	0	3	0	97
PC <5 years old* ($p < 0.023$)	29	32	7	33
PC >5 years old	18	17	15	50
Printer	29	23	14	34
Scanner	13	17	3	68
Telephone				
Payphone* ($p < 0.001$)	0	0	24	76
Videophone	1	5	0	94
Landline* ($p < 0.001$)	96	4	0	0
Fax* ($p < 0.001$)	15	15	31	40
Mobile phone ($p < 0.015$)	56	17	1	26
TV and VCR				
Cable TV	92	1	0	7
Digital Cable TV* ($p < 0.001$)	38	7	0	55
DVD	40	20	6	35
Video recorder/player* ($p < 0.001$)	48	12	2	38
Other entertainment				
Personal music player	14	19	0	68
CD player	48	11	7	33
Digital radio	55	11	11	23
Analog radio	48	5	5	42
Digital Camera* ($p < 0.05$)	22	35	1	42
Video camera* ($p < 0.035$)	13	29	2	56
Handheld games machines	2	27	0	71
Video games machine	0	33	0	68

* Statistically significant difference between US and Israel.

4. Results

The US respondents were all nursing home residents. They were significantly better educated ($p < 0.001$) than the Israeli respondents and were more likely to live without a partner ($p < 0.001$). These facts, however, may be mutually dependent, as people who enjoy a higher financial status (known to positively correlate with education), are not very healthy, and live alone may have a greater tendency to move to relatively expensive nursing homes such as those where the data were collected in the US. Therefore, we conducted the various tests with due attention to statistically significant differences between the populations (Table 3).

4.1. *Older adults' access to technology and support*

While this paper focuses primarily on ICT use by older people, use of non-ICT technologies, both traditional and modern, was also examined in order to determine whether older people are generally technophobic (refrain from adopting any type of modern technology) or selectively adopt technologies they perceive as useful for their specific needs. Therefore, respondents were asked about use of and accessibility to both traditional and modern common technologies, such as phones and entertainment equipment, in addition to computers and peripherals.

Accessibility of technology was graded from more accessible (own/at home), to less accessible (family/friends, public places), to no access. The responses listed reflect the highest-graded location indicated by the respondent (Table 4).

4.1.1. *Accessibility of ICT*

Twenty nine percent of the respondents had first-grade accessibility (owned or had access at home) to PCs that were less than 5 years old (Table 4). 18% of the respondents had the same level of accessibility to PCs that were older than five years, and 9% owned a laptop or had one at home. Assuming that most respondents had either a laptop, a newer PC or an older PC (but not both), these three figures mean that 56% of respondents had access to a PC at home. There was no significant difference in first- and second-grade accessibility between Israeli and US respondents. Twenty two percent of the respondents indicated they could access a PC elsewhere, mainly Americans who referred to public computer rooms at their nursing homes. Together these two figures indicate that nearly 80% of the respondents had fairly easy access to computers.

Regarding other technologies, 56% of the respondents owned or had at home mobile phones, 92% had cable TVs, and 38% had digital cable TV; 55% had digital radios, 40% had DVDs, and 22% had digital cameras. Israeli respondents had more first-grade access to digital cameras ($\chi^2 = 12.05$, df = 4, $p = 0.017$), to fax machines ($\chi^2 = 22.92$, df = 5, $p < 0.001$), to mobile phones ($\chi^2 = 12.36$, df = 4, $p = 0.015$), and to video

Table 5 – Older adults' potential access to computers.

Site of Access	%
A relative's home	66
Home	48
Library	29
A friend's home	21
A community center	15
School/university	13
Work/place of study	10
Museum/science center	10
A pay-per-use' site (e.g. Internet café)	9

cameras ($\chi^2 = 8.63$, df = 3, $p = 0.035$) than the US respondents. For example, 33% of Israelis owned or could access at home a digital camera, whereas this was the case for only 11% of the Americans. Compared to results in Selwyn el al.'s study, slightly more people in our sample had first-grade access to mobile phones (56% vs. 50%), and significantly more to DVD players (40% vs. 10%), perhaps due to transition from video recorders/players to the more modern technology (48% vs. 80%). A similar picture emerged in regard to digital cameras and digital radios. Additionally, first-grade accessibility to PCs nearly doubled overall (from 28% to 56%), but nearly tripled (to 68%) for the Israeli respondents, the majority of whom lived at home and hence were more comparable to the UK sample. This increase in rate of adoption can be attributed to an accelerated pace of ICT adoption by older people, and the difference between the Israeli and American populations possibly results from the technology-savvy character of Israeli culture, although this assumption requires further substantiation.

The results indicate that modern technologies are indeed adopted by older adults, supporting the assumption that this population *selectively* adopts technologies perceived as beneficial to them, albeit perhaps more slowly than the younger population. The results further imply that older people are participating more than ever in the technological era and associated culture.

Respondents were then asked to indicate where they could have accessed a PC had they wanted to (Table 5). Interestingly, all respondents indicated they could have done so, with no difference between the two populations.

Potential sites for PC access were similar in our study and in Selwyn et al.'s, with a relative's home, own home, a friend's home and a library emerging as the four most accessible sites, in descending order.

Overall, 63% of the respondents ($n = 77$) had used computers before, 33% ($n = 41$) of them at work. Forty percent ($n = 25$) of the Americans and 43% ($n = 26$, insignificant difference) of the Israelis (total 41.5%) indicated they had used a PC in the last 12 months (these will henceforth be termed 'users', as opposed to the rest – the 'non-users'). Determinants relating to older adults' access to and use of ICT will be analyzed next, considering users and non-users separately to gain a clearer picture. Americans and Israelis will be analyzed separately whenever differences are statistically significant.

4.1.2. *Accessibility of support*

As prior research had highlighted lack of access to support as a barrier to ICT use by elderly people [56,57], we asked users about actual sources of support and non-users about potential sources of support had they needed any (Table 6). Table 7 presents data regarding available sources as indicated by users and non-users.

Table 6 – Actual and potential sources of support.

Source of support	Users ($n = 51$)	Non-users ($n = 72$)
	Actual %	Potential %
Own/Partner	65	2
Children	43	37
Household	8	1
Family	16	21
Neighbors	10	2
Friends	16	7
Others	30	13

Table 7 – Number of accessible support resources.

Number of accessible support sources	Users	Non-users
	Actual %	Potential %
1	45	68
2	27	24
3	16	7
4	8	1
5	2	0
6	2	0
7	0	0

Non-users and users alike indicated their main sources of support were their children and other family members, yet 65% of the users mentioned that they actually relied on themselves or on a partner; the latter, however, were mentioned as a potential sources by only 2% of non-users. Interestingly, all non-users mentioned they could enlist support from at least one source, yet clearly the level of accessibility was lower than for users.

4.2. *Determinants of technology use*

To refine our understanding of the association between accessibility and use, we grouped the respondents according to access to PCs and support. Following Selwyn et al., people were classed into five groups: (1) core access—newer PCs and close support (nearby relatives, neighbors, or friends), (2) peripheral home access—older PCs and some support, (3) remote access—access at family's or friends' homes and support, (4) public access and support (close or remote), and (5) no access. The distribution of the populations among the five groups and the level of PC use within each group are displayed in Table 8.

Difference in level of use among the five groups was statistically significant (Mann–Whitney $U < 0.001$) and not unexpectedly showed that accessibility to equipment and support is strongly associated with actual use.

A closer look at the frequency of use of various technologies revealed that, as could have been anticipated, most respondents watched TV, listened to the radio, and in Israel also used a mobile phone (Table 9). Thirty-three percent of the respondents indicated they used a PC at home very often, more often than they watched video/DVD. Hence in our study use of a PC was by no means a negligible activity, in contradistinction with the findings of Selwyn et al. Clearly, home was the preferred

Table 8 – Level of access to computers by location and support proximity.

Level of accessibility	N	Number of users	% (within)
Core	39	34	87
Peripheral home	15	12	80
Remote	38	3	8
Public	8	2	25
No	23	0	0
Total	123	51	42

Table 9 – Frequency of technology use.

	Very often			Fairly often			Rarely			Never		
	US	Israel	Total	US	Israel	Total	US	Israel	Total	US	Israel	Total
Watch TV	94	98	96	3	2	2	3	0	2	0	0	0
Watch video/DVD	17	22	20	21	20	20	14	25	20	48	33	41
Listen to music via Hi-Fi	38	35	37	17	10	14	10	12	11	35	43	39
Listen to Radio*	54	82	67	19	5	12	10	5	7	17	8	13
Play video games	0	2	1	0	2	1	5	5	5	95	92	93
Talk on mobile phone*	32	60	46	5	3	4	10	7	8	54	30	42
Send/receive SMS	3	13	8	2	0	1	5	12	8	90	75	83
Use a PC by location												
Home	33	32	33	0	7	3	6	0	3	60	62	61
Relatives	0	2	2	3	5	4	6	2	4	90	88	89
Friends	0	3	2	0	0	0	0	0	0	100	97	98
Workplace*	2	12	7	2	0	1	0	0	0	97	88	93
Public places	8	10	9	11	10	11	3	2	2	78	78	78

* Statistically significant difference between US and Israel (χ^2 test, $p < 0.05$).

location for using a PC (100% of the actual users), with the possibility of accessing a PC at the homes of family or friends rated very low. Public places, in contrast, were rated higher by both populations, possibly referring to public computer rooms at nursing homes, yet perhaps lending some support to the call of Selwyn et al. [12] to make PCs available in public places for the use of otherwise excluded populations.

4.2.1. *Activities comprising ICT use by older adults*

The computer activity cited by users as most common was sending/receiving e-mails, followed by writing documents and playing computer games (Table 10). While the first two were similarly rated in Selwyn's study, playing games was quite negligible. Thus we see that older adults do indeed make use of computers for social activities and entertainment more frequently than before, as is the case with younger users.

Although the above results generally support Selwyn et al.'s conclusions from data collected in 2000, we see some improvement in the rate of PC use, particularly among 'younger olds', as well as in the variety of activities performed.

4.3. *A closer look at computer use by older adults*

Although all respondents indicated having some level of access to PCs and support, and although 63% ($n = 77$) indicated they had used computers before, only 42% ($n = 51$) were actual users (i.e. said they had used a PC in the last 12 months). Hence some older adults with prior experience in using a PC, despite having access to both the technology and related support, chose not to. The question is, why? We attempted to arrive at an answer by analyzing the effect of personal and social characteristics on PC use and then examining PC use by our respondents under the TPB. Finally, we analyzed the respondents' direct answers to this question.

4.3.1. *Personal and social characteristics and PC use*

A binary logistic regression allowing assessment of the singular effect of each independent variable on the dependent variable, as well as the effect of interactions among variables, was employed to gain more insight into the role of personal characteristics in determining use. 'Used a PC last year' (0: no, 1: yes) was the dependent variable, and country, gender, age group, health status, marital status, and education were the independent variables. All the independent variables were factorial, with age grouped into four categories: 60–69, 70–79, 80–89, and >90. We used the backward stepwise method with Wald as the stop criterion, and ran the regression with the independent variables and the interaction between health and age. The full results of the binary logistic regression are presented in Appendix B.

The model fitted the data well, as evidenced by the insignificant χ^2 in the model summary and the significant χ^2 for the omnibus tests of the model coefficients. It took five steps to converge, explained between 31% (Cox and Snell) and 42% (Nagelkerke R-square) of the variance in use, and substantially improved model predictive power (from 59% to 77%). Multicollinearity was negated since the highest variance inflation factor (VIF) value of the independent variables was 1.469, well below even the strict value of 2.5–3 used as multicollinearity cutoff value [58,59].

Having a partner, age, and being better educated had a significant effect on use (Table 11). The odds for PC use were 6.6

Table 10 – Computer-based activities.

Activities ($n = 51$)	Very often (%)	Often (%)	Rarely (%)	Never (%)
Sending/receiving e-mails	73	6	2	20
Writing and editing documents and letters	43	10	6	41
Playing games	41	12	8	39
Online banking/personal financial activities	29	8	0	63
Searching information about jobs/education/business	29	10	8	53
Navigate/surf without a specific purpose	28	18	10	45
Organizing files	26	12	6	57
Learning by a computer software	22	4	8	67
Watching adult entertainment	22	8	2	69
Listening to music on a computer	20	12	8	61
Surfing/navigating to acquire personal knowledge	20	16	12	53
Collecting information about or searching products/services	12	29	16	43
Creating and manipulating images (e.g. photos)	10	8	8	75
Downloading software/music/movies/computer pictures	8	8	4	80
Watching DVD on the computer	6	10	14	71
Participating in chats/forums	6	4	0	90
Purchasing products/services	4	12	16	69
Making movies and computer animations	2	4	0	94
Programming	2	0	4	94
Creating/maintaining a personal website	2	2	4	92
Taking online courses or lessons	2	8	2	88
Making music with a computer	0	0	0	100

times greater (an increase of 660%) for older adults living with a partner than for persons who lived alone. Age negatively affected use, with odds for computer use among respondents aged 70–79, 80–89, and >90 respectively 90%, 85%, and 93% lower than for a person aged 60–69. Older people with higher education were 3.1 times (an increase of 310%) more likely to use a PC as compared with respondents with a lower educational level. Interestingly, health on its own was insignificant, yet had a major effect when interacting with age. Thus, being 70–79 and healthy increased the odds of use 4.4 times, while being a healthy 80–89-year-old increased the odds 14 times as compared with being unhealthy! Being >90 and healthy, however, had no significant effect. It therefore seems that health is actually moderating the effect of age on use. This result might explain the mixed findings of previous studies concerning the effect of health on ICT use and carries significant implications for the potential adoption of ICT by unhealthy older adults.

4.3.2. *TPB and PC use by older adults*

TPB explains that the behaviors of individuals are positively influenced by a positive attitude toward the behavior as well as by perceived behavioral control over resources and efforts associated with undertaking the behavior. These individuals are also positively influenced when important and influential people around them think they should undertake the behavior (SN). Morris and Venkatesh [43] supported the conjecture that older employees placed less importance on attitude but more on PBC and SN. Hence, adapting TPB to the present context, it was posited that older people with a more positive attitude toward PC use and a higher PBC as well as a more highly valued SN will have a greater tendency to use a PC.

As stated above, we used the measures employed by Morris and Venkatesh, though in view of the different context and Likert scale, we re-tested their reliability and validity. A principal factor analysis extracted three factors with eigenvalues greater than 1, as expected, and loadings of the items

Table 11 – Variables affecting PC use.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
								Lower	Upper
Step 5	Partner[a]	1.886	.498	14.367	1	.000	6.595	2.487	17.492
	Age (60–69)			11.149	3	.011			
	Age 1 (70–79)	−2.322	.795	8.539	1	.003	.098	.021	.466
	Age 2 (80–89)	−1.883	.715	6.941	1	.008	.152	.037	.617
	Age 3 (90+)	−2.654	.938	8.004	1	.005	.070	.011	.443
	Higher education[b]	1.139	.489	5.431	1	.020	3.125	1.199	8.148
	Age × Healthy			7.847	3	.049			
	Age(1) × Healthy(1)[c]	1.490	.767	3.769	1	.052	4.435	.986	19.953
	Age(2) × Healthy(1)	2.653	1.334	3.953	1	.047	14.196	1.039	194.059
	Age(3) × Healthy(1)	−18.961	22667.023	.000	1	.999	.000	.000	.
	Constant	−.076	.687	.012	1	.911	.926		

[a] Compared to living alone.
[b] Compared to high-school or less.
[c] Compared to being unhealthy.

Table 12 – Parameters of the binary logistic regressions.

	US sample ($N = 63$) Final step (7)	Israeli sample ($N = 60$) Final step (9)
Classification table improvement	From 53% to 81%	From 56% to 88%
R-Square (Cox & Snell to Nagelkerke)	Between 45% and 59%	Between 47% and 63%
Hosmer & Lemeshow test	$\chi^2 = 8.58$, df = 8, $p = 0.379$	$\chi^2 = 12.35$, df = 8, $p = 0.136$
Variables in the final equation	PBC, Age × ATT	PBC, Age × SN

Table 13 – Variables in the binary logistic regression equations.

		B	S.E.	Wald	df	Sig.	Exp(*B*)	95% C.I. for EXP(B)	
								Lower	Upper
US sample									
Step 7	PBC	1.568	.509	9.489	1	.002	4.796	1.769	13.003
	Age × Att			8.992	3	.029			
	Age(1) × Att	2.663	1.279	4.333	1	.037	14.344	1.169	176.087
	Age(2) × Att	.846	.553	2.345	1	.126	2.331	.789	6.886
	Age(3) × Att	4.134	2.514	2.703	1	.100	62.403	.452	8615.233
	Constant	.382	.382	1.001	1	.317	1.465		
Israeli sample									
Step 9	PBC	1.166	.461	6.407	1	.011	3.208	1.301	7.912
	Age × SN			8.269	3	.041			
	Age(1) × SN	−1.823	.840	4.717	1	.030	.161	.031	.837
	Age(2) × SN	−1.199	.810	2.189	1	.139	.301	.062	1.476
	Age(3) × SN	−4.396	3.896	1.273	1	.259	.012	.000	25.522
	Constant	.300	.432	.481	1	.488	1.350		

on their respective factors were significant and clean with the exception of one item ('A computer is not compatible with other technologies I use'), which was culled. Cronbach alpha values were between 0.79 and 0.91, and correlations among the factors were sufficiently small to negate multicollinearity effects, with independent variable multicollinearity already ruled out in the previous section Appendix C. These indicators attest to the convergent and discriminant validity of the factor scales. However, having noticed a salient difference between responses of Americans and Israelis, we analyzed them separately. The full results of the two regressions are displayed in Appendices D and E. In spite of the sufficient goodness-of-fit indicators, results should be interpreted with caution due to the relatively small sample size of the two sub-groups, which was reduced further due to omission of cases with missing values.

Intention to use a computer in the forthcoming 12 months (scale: do not intend, perhaps: 0, intend, definitely intend: 1) was the dependent variable, while the values of the three factors as calculated by SPSS during the factor analysis were the independent variables. Age (classed into four groups as above) was taken as an independent variable, as were factors expressing the interaction of age with each of the TPB factors (i.e. Age × ATT, Age × PBC, Age × SN).

Both models demonstrated good fit to the data as shown in Table 12 and explained about 50% of the variance in intention to use a computer.

PBC emerged as a strong predictor of intention to use a computer in both populations (Table 13). Each increase by one standard deviation in PBC increased the odds of using a computer by 480% in the US population, and by 320% in the Israeli population. Contrary to TPB, the other two factors (ATT and SN) were insignificant determinants of use, as was age on its own. Rather, age moderated the effect of ATT in the American sample and of SN in the Israeli sample. Contrary to the findings of Morris and Venkatesh, age *increased* the impact of ATT, though only for age group 70–79. While age had no effect on ATT in the Israeli sample, it moderated the effect of SN, though again only for age group 70–79. Thus, age reduced the effect of SN on the intention to use a computer among Israeli respondents, contrary to the findings of Morris and Venkatesh.

Table 14 – Reasons for not using a computer.

	US (%)	Israel (%)	Total (%)
No need	37	38	38
Not Interesting	21	26	24
Too old	18	15	17
Don't know how	5	15	10
Too difficult	5	6	6
No access	13	9	11
Too expensive	16	3	10
Medical problem	3	12	7
Don't like	3	0	1

Although the above results shed light on the barriers to computer use, we sought to achieve a deeper understanding by asking non-users to indicate reasons for their behavior (with multiple reasons allowed; see Table 14).

Quite surprisingly, answers do not reflect technophobia or an inherent reluctance to use technology, but rather a cognitive choice, as 62% of non-users said they did not use computers because there was 'no need' or it was 'not interesting', whereas only 23% perceived computer use as too difficult or indicated they were too old to learn. 'No access' or 'don't know how' was indicated by 21%, whereas 10% mentioned computers were too expensive. Only one respondent indicated 'don't like' as a reason. Similar results were found by Selwyn et al., so evidently there is more to ICT non-use than generally advocated by prior research.

Table 15 – Summary of evidence answering the research questions.

No.	Research Question	Answer
1	Age and ICT use	
	Does age still affect ICT use?	Yes, although there is an increase in the proportion of older adults who adopt modern technology and ICT. We still see that older people are less inclined to use technology, including ICT.
2	Patterns of use of ICT and other technology	
	What access to ICT do older adults have?	Most respondents indicated they could access ICT and support fairly easily.
	Where can older adults access ICTs? What access to support when using ICT do older adults have?	Mostly relative's homes, at own home, and at a public library.
	How does access to 'new' ICTs such as computers and the Internet compare with access to other technologies?	Core accessible to modern technologies as well as to ICT has increased compared with 2000. Modern technologies are adopted albeit selectively. Whereas some modern technologies have been widely adopted, ICT adoption still lags behind.
3	Personal characteristics affecting ICT use	
	What factors are associated with adults' access to ICT (e.g. gender, age, educational background, health conditions, and marital status)?	Education, marital status, and health, emerged as significant determinants of ICT use in addition to age. Health, however, was found to moderate the effect of age on use.
4	Use of ICT by older adults	
	What are older adults using ICT for?	Sending/receiving e-mails, writing and editing documents, playing games.
5	Reasons for non-use	
	What are the reasons behind older adults' non-use of ICT?	Perceived behavioral control and 'no need'.

5. Discussion

ICT has revolutionized our lives in terms of access to information. Yet for several segments in population, particularly elderly people, the 'digital barrier' remains. The older people are, the less likely they are to use ICT [2]. Is this a temporary situation? Will future older adults more readily adopt ICT in general and technology related to healthcare in particular? Before attempting an answer or referring to the research questions, a review of the limitations of this study is in order.

6. Limitations

The small sample size was a major limitation because it restricted the statistical tests that could be employed and reduced statistical power. In addition, generalizability is limited due to the employment of a sample of convenience. Likewise, the salient differences between the two populations imply possible cultural effects which merit further study. Future research should aim to collect data from a larger and more representative sample in various countries to extend the internal and external validity of the results.

6.1. *Answers to the research questions*

Computers have been part of the industrialized world for more than three decades, and today's older adults are not as detached from technology as before. Research supports the importance of prior experience, leading several scholars to maintain that the inclusion of older people in the digital world is just a matter of time. This issue is addressed by the first question formulated in the present study. Our results point to answers to this and to the other research questions, as summarized in Table 15.

Age remains a significant negative determinant of use of technology in general and ICT in particular, although there has been an increase in adoption rate as compared with data collected in 2000. Indeed, perceived behavioral control, which decreases with age – possibly due to cognitive and physical impairments – was found to positively affect ICT use. Adoption of ICT, however, lags behind adoption of other types of modern technologies, such as digital cameras, DVDs and cell phones, whose rate of use by older adults is quite high albeit different between the two sample populations. This difference merits further research.

The results show that accessibility of ICT is a diminishing issue, as is the accessibility of support, although both still emerged as important determinants of ICT use by the elderly. People clearly prefer to use computers at home rather than at relatives or in public places, as could have been anticipated. We therefore conclude that accessibility is no longer a strong barrier to PC use, although we acknowledge the importance of close support. Looking at results obtained about a decade ago, it appears there has been an increase in adoption of all forms of technology. However, many older people are somewhat reluctant to adopt new technologies – whether ICT or other applications – unless they become convinced that these technologies confer significant benefits. This conclusion follows from the reasons cited by respondents in this study and that of Selwyn et al., which suggest that older adults refrain from using technologies they are not interested in or have no need for. While prior research [15] and current practice (http://www.statistics.gov.uk/cci/nugget.asp?ID=949) concur that ICT can improve the quality of life of older adults, many remain unconvinced. It is therefore essential to find ways of bridging the gap between the perceptions of providers and those of older customers regarding potential benefits of ICT.

Corroborating prior research, education, marital status, and health emerged as significant determinants of ICT use in addition to age. Health, however, was found to moderate the effect of age on use, possibly explaining the mixed results cited in the literature. It seems that health as such is not so much a barrier as a factor capable of augmenting the effect of age on use. Healthy older people are many times more likely to use PCs. While this is an encouraging finding if we believe that advances in medicine imply healthier older adults, it carries significant implications for providers of healthcare-related technologies targeting unhealthy older people. An additional concern is the positive effect of living with a partner, which suggests that older people living alone, for whom ICT is posited to facilitate social inclusion and better healthcare, may be the very ones less likely to use it.

Although a growing number of elderly have adopted newer technologies, their usage level is basic, and it seems that depth of use has yet to be addressed. For example, searching for products or information, online purchasing and online banking scored low on the usage list. This is clearly not a positive sign from the standpoint of penetration of healthcare-related ICT among older adults.

Contrary to the theory of planned behavior, attitude and subjective norm did not emerge as affecting ICT use, although both significantly interacted with age to affect use, albeit differently for the two populations. Quite intriguing is the fact that the most prevalent direct reason given for non-use was 'no need', supporting the assertion that if older adults are to be induced to adopt ICTs, the benefits have to be clearly demonstrated.

7. Conclusions

Seen from the perspective of older adults' use of ICT in the healthcare context, the results presented in this study are variously encouraging and discouraging. On the positive side, we see that the participation rate among the 'youngest old' aged 60–69 nears 8% and that there is a significant increase in the rate of ICT use by older people compared with results from data collected a decade ago. Most of our respondents had reasonable access to computers and to some degree of support, yet the availability of a close source of support is still as important as it was seven years ago; nowadays, however, nearby support seems more readily available. On the other hand, while older people do adopt modern technology, they are quite selective and tend to invest resources only when the expected benefits far exceed those provided by more traditional technologies with similar functions.

We maintain that the prospects for older adults using ICT are better than ever since education and health have emerged as significant determinants of PC use, on the one hand, and on the other it is likely that future older adults in the industrialized countries will be healthier and better educated, as well as more proficient in computer use.

On the less positive side, the effects of accessibility of support and of health and marital status on ICT use may pose significant barriers to adoption of healthcare-related ICT now and in the future, in spite of encouraging advances.

Health status seems to be a strong moderating factor affecting PC use. Thus, unhealthy people may be less inclined to adopt ICT, including applications intended to improve their quality of life, possibly due to lower perceived behavioral control caused by physical or cognitive weakness. Therefore providers of such technologies should ensure that potential consumers have first-grade access to support from nearby family, friends, or neighbors. Potential adopters should clearly comprehend the benefits that can accrue from the new technology. The significance of perceived usefulness as a determinant of ICT use is another conclusion that emerges from reasons given by respondents for non-use. Similarly to results reported by Selwyn et al., the majority of respondents in our study claimed that computers were of no interest to them and that they did not feel a need to use them. The superior capacity of new healthcare related technology to improve their health status and quality of life compared with simpler traditional technologies has to be made obvious and irrefutable.

As shown by the results of the TPB analysis, attitude toward use becomes more important as people grow older, at least as regards the US sample. This finding suggests that, above and beyond pressure from close relatives and friends, efforts to influence positive attitude are warranted. The divergences between the American and Israeli respondents, however, may imply cultural differences in this regard. Such differences, if substantiated by further research, should be taken into account, and suggest that diffusion approaches should be adapted to the specific characteristics of potential consumers. Future research should investigate these differences.

In common to both populations, PBC emerges as the most important determinant of use among the three TPB factors. Hence every introduction of new healthcare-related ICT should not only offer straightforward and easy-to-use technology, it must also be bundled with a comprehensive training program. Any new technology that differs significantly from technologies in which older adults are already proficient is likely to encounter adoption difficulties now and in the future due to the cognitive and physiological impairments that affect PBC among the elderly.

Currently, the results do not fully support a bright future for health-related ICT targeting older people—unless the technology is kept simple, is seen to be useful, and is bundled with first-rate support.

Author contributions

Tsipi Heart initiated, designed, and supervised this research. She has also guided the writing of the dissertation, verified and improved the data analysis, and wrote the submitted manuscript.

Efrat Kalderon conducted the research as part of her graduate studies. She collected the data, analyzed the data, and wrote a dissertation based on the results.

Both authors substantially contributed to the present work.

Competing interests

We hereby declare that there is no conflict of interests related to this work.

Summary points

"What was already known on the topic"

- Health expenses for older adults increase, ICT is believed to assist in providing more cost-effective healthcare to this population.
- Prior effort in this direction has marginally succeeded.
- Older people use of technology lags behind younger people.
- Apart of age, other personal and social factors, such as health, education, and marital status, were found to affect ICT use by older adults.
- According to the theory of planned behavior (TPB), ICT use should be determined by attitude toward use ATT), perceived behavioral control (PBC), and subjective norm (SN). Age was found to moderate these factors in a workplace.

"What this study added to our knowledge"

- There is an increase in use of technology in general, and of ICT use in particular compared with data collected in 2000.
- Nonetheless, most findings of the above study were still supported by the present data collected in 2007–2008. Age was still a barrier to ICT use.
- Health was found to augment the effect of age on ICT use.
- TPB was only partially supported in the present study setting, implying that intention to use a computer by older adults is mainly affected by PBC yet not by ATT and SN. Age was found to moderate the effects of ATT in the American sample, and of SN in the Israeli sample, possibly implying an association between TPB and culture. Additionally, the effect of age on ATT and SN was opposite to findings in prior research.
- The results show that older adults are not yet ready to easily adopt health-related ICT. However, in order for this to materialize, the application should render salient benefits above and beyond traditional technologies, be simple to use, and be provided with adequate support.

The work was self-funded by the authors, without involvement of any institution or external funding resource.

The first author is a full-time employee of an academic institute, and the second author is a full-time employee of a firm whose area of interest is unrelated to the topic of this paper.

Appendix A. TPB Items (adapted from Morris and Venkatesh, 2000)

Intention to use:

Assuming you had access to a computer, would you use it during the forthcoming 12 months?

Do not intend	Perhaps	Intend	Definitely intend
01	02	03	04

Attitude (ATT):

Using computers is a (bad/good) idea:

Very bad	Bad	Good	Very good
01	02	03	04

Using computers is a (foolish/wise) idea:

Very foolish	Foolish	Wise	Very wise
01	02	03	04

I (dislike/like) the idea of using computers:

Dislike very much	Dislike	Like	Like very much
01	02	03	04

Using computers is (unpleasant/pleasant):

Very unpleasant	Unpleasant	Pleasant	Very pleasant
01	02	03	04

Subjective Norms (SN):

People who influence my behavior think that I should use a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

People who are important to me think that I should use a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

Perceived Behavioral Control (PBC):

I have control over using a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

I have the resources necessary to use a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

I have the knowledge necessary to use a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

Given the resources, opportunities and knowledge it takes to use a computer, it would be easy for me to use a computer:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

A computer is not compatible with other technologies I use:

Strongly do not agree	Do not agree	Agree	Strongly agree
01	02	03	04

Appendix B. Results of the Binary Logistic Regression – Personal Characteristics

Case Processing Summary.

Unweighted Cases[a]	N	Percent
Selected Cases		
Included in Analysis	123	100.0
Missing Cases	0	0
Total	123	100.0
Unselected Cases	0	0
Total	123	100.0

[a] If weight is in effect, see classification table for the total number of cases.

Categorical Variables Codings

	Frequency	Parameter coding		
		(1)	(2)	(3)
Age				
age 60–69	18	.000	.000	.000
age 70–79	40	1.000	.000	.000
80–89	46	.000	1.000	.000
age 90+	19	.000	.000	1.000
Country				
U.S.	63	.000		
Israel	60	1.000		
Partner				
.00	80	.000		
1.00	43	1.000		
Gender				
Male	39	.000		
Female	84	1.000		
Edu2Cat				
High school or Lower	59	.000		
Higher education	64	1.000		
Healthy				
.00	97	.000		
1.00	26	1.000		

Block 0: Beginning Block

Classification Table[a,b]

Observed		Predicted		
		Used a PC last year		Percentage Correct
		No	Yes	
Step 0	last year use computer			
	No	72	0	100.0
	Yes	51	0	.0
	Overall Percentage		58.5	

[a]Constant is included in the model.
[b]The cut value is .500.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	−.345	.183	3.550	1	.060	.708

Block 1: Method: Backward Stepwise (Wald)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	50.973	11	.000
	Block	50.973	11	.000
	Model	50.973	11	.000
Step 5[a]	Step	−2.034	1	.154
	Block	45.368	8	.000
	Model	45.368	8	.000

[a] A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	115.938[a]	.339	.457
5	121.543[a]	.308	.415

[a] Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.367	8	.498
5	4.765	7	.689

Classification Table[a]

Observed		Predicted last year use computer		Percentage Correct
		No	Yes	
Step 1	last year use computer			
	No	61	11	84.7
	Yes	14	37	72.5
	Overall Percentage		79.7	
Step 5	last year use computer			
	No	61	11	84.7
	Yes	17	34	66.7
	Overall Percentage		77.2	

[a] The cut value is .500.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(*B*)	95% C.I. for Exp(*B*)	
								Lower	Upper
Step 1[a]	Healthy(1)	20.606	19914.111	.000	1	.999	889288066.917	.000	.
	Partner(1)	1.823	.586	9.683	1	.002	6.188	1.963	19.503
	Gender(1)	−.710	.522	1.852	1	.174	.492	.177	1.367
	Age			6.425	3	.093			
	Age(1)	−1.870	.820	5.195	1	.023	.154	.031	.770
	Age(2)	−1.433	.748	3.672	1	.055	.238	.055	1.033
	Age(3)	−2.068	.987	4.392	1	.036	.126	.018	.875
	Edu2Cat(1)	.962	.549	3.070	1	.080	2.618	.892	7.684
	Country(1)	−.424	.594	.510	1	.475	.654	.204	2.096
	Age × Healthy			.164	3	.983			
	Age(1) × Healthy(1)	−18.956	19914.111	.000	1	.999	.000	.000	.
	Age(2) × Healthy(1)	−18.302	19914.111	.000	1	.999	.000	.000	.
	Age(3) × Healthy(1)	−39.895	29364.191	.000	1	.999	.000	.000	.
	Constant	.216	.941	.052	1	.819	1.240		
Step 5[a]	Partner(1)	1.886	.498	14.367	1	.000	6.595	2.487	17.492
	Age			11.149	3	.011			
	Age(1)	−2.322	.795	8.539	1	.003	.098	.021	.466
	Age(2)	−1.883	.715	6.941	1	.008	.152	.037	.617
	Age(3)	−2.654	.938	8.004	1	.005	.070	.011	.443
	Edu2Cat(1)	1.139	.489	5.431	1	.020	3.125	1.199	8.148
	Age × Healthy			7.847	3	.049			
	Age(1) × Healthy(1)	1.490	.767	3.769	1	.052	4.435	.986	19.953
	Age(2) × Healthy(1)	2.653	1.334	3.953	1	.047	14.196	1.039	194.059
	Age(3) × Healthy(1)	−18.961	22667.023	.000	1	.999	.000	.000	.
	Constant	−.076	.687	.012	1	.911	.926		

[a] Variable(s) entered on step 1: Healthy, Partner, Gender, Age, Edu2Cat, Country, Age × Healthy.

Appendix C. Validation of the TPB measurement model

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	4.455	44.547	44.547
2	1.640	16.401	60.948
3	1.121	11.209	72.157
4	.700	7.003	79.160
5	.588	5.879	85.039
6	.433	4.333	89.372
7	.385	3.848	93.220
8	.306	3.060	96.280
9	.225	2.247	98.527
10	.147	1.473	100.000

Component extraction.

	Component (Cronbach Alpha)		
	Attitude (0.84)	SN (0.91)	PBC (0.79)
Using computer bad/good	.813	.154	.247
Using computer foolish/wise	.780	.242	−.024
Using computer like/dislike	.816	.158	.327
Using computer pleasant/unpleasant	.768	.052	.047
People who influence my behavior think that I should use a computer	.226	.896	.217
People who are important to me think that I should use computers	.200	.904	.241
I have control over using a computer	.021	.094	.865
I have the resources necessary to use a computer	.039	.275	.658
I have the knowledge necessary to use a computer	.360	.253	.669
Given the resources, opportunities and knowledge it takes to use a computer, it would be easy for me to use a computer:	.202	.070	.799

Results of the principal components factor analysis Component Correlation Matrix

Component	Att	SN	PBC
1	1.000		
2	−.282	1.000	
3	−.386	.371	1.000

Extraction Method: Principal Component Analysis.Rotation Method: Direct Oblimin with Kaiser Normalization.

Appendix D. Results of the Binary Logistic regression: TPB and Age for the US Sample

Case Processing Summary[b]

Unweighted Cases[a]	N	Percent
Selected Cases		
Included in Analysis	59	93.7
Missing Cases	4	6.3
Total	63	100.0
Unselected Cases	0	.0
Total	63	100.0

[a] If weight is in effect, see classification table for the total number of cases. [b]country = USA.

Categorical Variables Codings[a]

Age	Frequency	Parameter coding		
		(1)	(2)	(3)
Age 60–69	8	.000	.000	.000
Age 70–79	17	1.000	.000	.000
80–89	25	.000	1.000	.000
age >90	9	.000	.000	1.000

[a]Country: USA.

Block 0: Beginning Block
Classification Table[a,b,c]

Observed			Predicted		
			Intention to use		Percentage Correct
			.00	1.00	
Step 0	Intention	.00	0	28	.0
		1.00	0	31	100.0
	Overall Percentage			52.5	

[a]Country: USA.
[b]Constant is included in the model.
[c]The cut value is .500.

Variables in the Equation[a]

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.102	.261	.152	1	.696	1.107

[a] Country: USA.

Block 1: Method: Backward Stepwise (Wald)
Omnibus Tests of Model Coefficients[b]

		Chi-square	df	Sig.
Step 1	Step	49.582	15	.000
	Block	49.582	15	.000
	Model	49.582	15	.000
Step 7[a]	Step	−7.698	3	.053
	Block	34.701	4	.000
	Model	34.701	4	.000

[a] A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step. [b]country: USA.

Model Summary[c]

Step	(2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	32.056[a]	.568	.759
7	46.938[b]	.445	.593

[a] Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.
[b] Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.
[c]Country: USA.

Hosmer and Lemeshow Test[a]

Step	Chi-square	df	Sig.
1	4.805	8	.778
7	8.581	8	.379

[a]Country: USA.

Classification Table[a,b]

Observed			Predicted		
			Intention to use		Percentage Correct
			.00	1.00	
Step 1	Intention	.00	24	4	85.7
		1.00	5	26	83.9
	Overall Percentage			84.7	
Step 7	Intention	.00	22	6	78.6
		1.00	5	26	83.9
	Overall Percentage			81.4	

[a]Country: USA.
[b]The cut value is .500.

Variables in the Equation[b]

		B	S.E.	Wald	df	Sig.	Exp(*B*)	95% C.I. for Exp(*B*)	
								Lower	Upper
Step 1[a]	Age			.316	3	.957			
	Age(1)	9.254	15695.268	.000	1	1.000	10442.610	.000	.
	Age(2)	9.834	15695.268	.000	1	1.000	18664.987	.000	.
	Age(3)	190.004	33172.209	.000	1	.995	3.292E82	.000	.
	Att_US	18.117	16187.889	.000	1	.999	73784169.991	.000	.
	PBC_US	21.592	15505.747	.000	1	.999	2383159760.457	.000	.
	SN_US	16.824	12180.337	.000	1	.999	20263717.762	.000	.
	Age × Att_US			1.252	3	.741			
	Age(1) × Att_US	(15.587	16187.890	.000	1	.999	.000	.000	.
	Age(2) × Att_US	(17.264	16187.889	.000	1	.999	.000	.000	.
	Age(3) × Att_US	268.187	48670.955	.000	1	.996	2.965E116	.000	.
	Age × PBC_US			.044	3	.998			
	Age(1) × PBC_US	(20.030	15505.747	.000	1	.999	.000	.000	.
	Age(2) × PBC_US	(19.712	15505.747	.000	1	.999	.000	.000	.
	Age(3) × PBC_US	16.417	17223.447	.000	1	.999	13486226.962	.000	.
	Age × SN_US			.078	3	.994			
	Age(1) × SN_US	(17.087	12180.337	.000	1	.999	.000	.000	.
	Age(2) × SN_US	(16.816	12180.337	.000	1	.999	.000	.000	.
	Age(3) × SN_US	62.932	20835.427	.000	1	.998	2.143E27	.000	.
	Constant	(9.640	15695.268	.000	1	1.000	.000		
Step 7[a]	PBC_US	1.568	.509	9.489	1	.002	4.796	1.769	13.003
	Age × Att_US			8.992	3	.029			
	Age(1) × Att_US	2.663	1.279	4.333	1	.037	14.344	1.169	176.087
	Age(2) × Att_US	.846	.553	2.345	1	.126	2.331	.789	6.886
	Age(3) × Att_US	4.134	2.514	2.703	1	.100	62.403	.452	8615.233
	Constant	.382	.382	1.001	1	.317	1.465		

[a] Variable(s) entered on step 1: Age, Att_US, PBC_US, SN_US, Age × Att_US, Age × PBC_US, Age × SN_US.
[b]Country: USA.

Appendix E. Results of the Binary Logistic regression: TPB and Age for the Israeli Sample

Case Processing Summary[b]

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	49	81.7
	Missing Cases	11	18.3
	Total	60	100.0
Unselected Cases	0	.0	
Total	60	100.0	

[a] If weight is in effect, see classification table for the total number of cases.
[b]Country: Israel.

Categorical Variables Codings[a]

Age	Frequency	Parameter coding		
		(1)	(2)	(3)
Age 60–69	8	.000	.000	.000
Age 70–79	22	1.000	.000	.000
80–89	14	.000	1.000	.000
Age >90	5	.000	.000	1.000

[a]Country: Israel.

Block 0: Beginning Block

Classification Table[a,b,c]

Observed			Predicted		
			Intention to use		Percentage Correct
			.00	1.00	
Step 0	Intention	.00	0	22	.0
		1.00	0	27	100.0
	Overall Percentage			55.1	

[a]Country: Israel. [b]Constant is included in the model. [c]The cut value is .500.

Variables in the Equation[b]

		B	S.E.	Wald	df	Sig.	Exp(*B*)
Step 0[a]	Constant	.205	.287	.508	1	.476	1.227

[a] Variable(s) entered on step 1: Age, PBC_Is, Att_Is, SN_Is, Age × SN_Is, Age × Att_Is, Age × PBC_Is.
[b]Country: Israel.

Block 1: Method: Backward Stepwise (Wald)

Omnibus Tests of Model Coefficients[a]

		Chi-square	df	Sig.
Step 1	Step	41.808	15	.000
	Block	41.808	15	.000
	Model	41.808	15	.000
Step 9	Step	8.228	1	.004
	Block	30.916	4	.000
	Model	30.916	4	.000

[a]Country: Israel.

Model Summary[c]

Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	25.609[a]	.574	.768
9	36.501[b]	.468	.626

[a] Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.
[b] Estimation terminated at iteration number 6 because parameter estimates changed by less than .001. [c]Country: Israel.

Hosmer and Lemeshow Test[a]

Step	Chi-square	df	Sig.
1	3.622	8	.890
9	12.350	8	136

aCountry: Israel.

Classification Table[a,b]

Observed			Predicted		
			Intention to use		Percentage Correct
			.00	1.00	
Step 1	Intention	.00	19	3	86.4
		1.00	2	25	92.6
	Overall Percentage			89.8	
Step 9	Intention	.00	19	3	86.4
		1.00	3	24	88.9
	Overall Percentage			87.8	

[a]Country: Israel. [b]The cut value is .500.

Variables in the Equation[c]

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
								Lower	Upper
Step 1[a]	Age			.108	3	.991			
	Age(1)	(5.812	15909.673	.000	1	1.000	.003	.000	.
	Age(2)	(5.448	15909.673	.000	1	1.000	.004	.000	.
	Age(3)	(27.329	59880.923	.000	1	1.000	.000	.000	.
	PBC_Is	16.498	16107.224	.000	1	.999	14627202.620	.000	.
	Att_Is	1.461	12902.765	.000	1	1.000	4.309	.000	.
	SN_Is	(6.835	11707.759	.000	1	1.000	.001	.000	.
	Age × SN_Is			.406	3	.939			
	Age(1) × SN_Is	4.928	11707.759	.000	1	1.000	138.119	.000	.
	Age(2) × SN_Is	3.424	11707.759	.000	1	1.000	30.699	.000	.
	Age(3) × SN_Is	6.835	73291.652	.000	1	1.000	929.914	.000	.
	Age × Att_Is			1.693	3	.638			
	Age(1) × Att_Is	(1.361	12902.765	.000	1	1.000	.256	.000	.
	Age(2) × Att_Is	(4.154	12902.765	.000	1	1.000	.016	.000	.
	Age(3) × Att_Is	(1.461	46563.719	.000	1	1.000	.232	.000	.
	Age × PBC_Is			.189	3	.979			
	Age(1) × PBC_Is	(15.773	16107.224	.000	1	.999	.000	.000	.
	Age(2) × PBC_Is	(16.279	16107.224	.000	1	.999	.000	.000	.
	Age(3) × PBC_Is	(16.498	72680.549	.000	1	1.000	.000	.000	.
	Constant	6.126	15909.673	.000	1	1.000	457.664		

Step 9[b]	PBC_Is	1.166	.461	6.407	1	.011	3.208	1.301	7.912
	Age × SN_Is			8.269	3	.041			
	Age(1) × SN_Is	(1.823	.840	4.717	1	.030	.161	.031	.837
	Age(2) × SN_Is	(1.199	.810	2.189	1	.139	.301	.062	1.476
	Age(3) × SN_Is	(4.396	3.896	1.273	1	.259	.012	.000	25.522
	Constant	.300	.432	.481	1	.488	1.350		

[a] Variable(s) entered on step 1: Age, PBC_Is, Att_Is, SN_Is, Age × SN_Is, Age × Att_Is, Age × PBC_Is.
[b] Variable(s) entered on step 8: PBC_Is.
[c]Country: Israel.

REFERENCES

[1] eHealth News, GE and Intel Invest US$ 250 million in New Market Opportunity, 2009 (accessed February 28 2010), available from: http://www.ehealthnews.eu/intel/1603-ge-and-intel-invest-250-million-in-new-market-opportunity
[2] M. Marschollek, S. Mix, K.-H. Wolf, B. Effertz, R. Haux, E. Steinhagen-Thiessen, ICT-based health information services for elderly people: Past experiences, current trends, and future strategies, Medical Informatics & the Internet in Medicine 32 (4) (2007) 251–261.
[3] A.-S. Melenhorst, W.A. Rogers, D.G. Bouwhuis, Older Adults' Motivated Choice for Technological Innovation: Evidence for Benefit-Driven Selectivity, Psychology & Aging 21 (1) (2006) 190–195.
[4] B. Bhattacharjee, Factors Affecting Computer Use Among Older Adult Users: A Study in the Backdrop of Florida State University in College of Information, The Florida State University, 2007, p. 217.
[5] M.D. Chinn, R.W. Fairlie, The determinants of the global digital divide: a cross-country analysis of computer and internet penetration. Oxford Economic Papers, 2006, p. 16–44.
[6] J.M. Kiel, The digital divide: Internet and e-mail use by the elderly, Informatics for Health and Social Care 30 (1) (2005) 19–23.
[7] N. Selwyn, The information aged: A qualitative study of older adults' use of information and communications technology, Journal of Aging Studies 18 (4) (2004) 369–384.
[8] N. Selwyn, Digital division or digital decision? A study of non-users and low-users of computers, Poetics 34 (4–5) (2006) 273–292.
[9] P. Gibby, J. Weingard, A. Bunker, Progress in Making e-services Accessible to All—Encouraging Use by Older People, National Audit Office (NAO), UK, London, UK, 2003.
[10] S. Jones, S. Fox, Generations Online in 2009. PEW INTERNET PROJECT DATA MEMO 2009 January 28, 2009 (accessed October 5, 2009).
[11] N. Adams, D. Stubbs, V. Woods, Psychological barriers to Internet usage among older adults in the UK, Informatics for Health and Social Care 30 (1) (2005) 3–17.
[12] N. Selwyn, S. Gorard, J. Furlong, L. Madden, Older adults' use of information and communications technology in everyday life, Ageing and Society 23 (5) (2003) 561–582.
[13] Ageing: Fastest increase in the 'oldest old', August 27, 2009 (accessed February 18 2009), available from: http://www.statistics.gov.uk/cci/nugget.asp?ID=949
[14] H.J. Lee, S.H. Lee, K.-S. Ha, H.C. Jang, W.-Y. Chung, J.Y. Kim, Y.-S. Chang, D.H. Yoo, Ubiquitous healthcare service using Zigbee and mobile phone for elderly patients, International Journal of Medical Informatics 78 (3) (2009) 193–198.
[15] S.J. Czaja, R. Schulz, Innovations in technology and aging introduction, Generations 30 (2) (2006) 6–8.
[16] S.J. Czaja, N. Charness, A.D. Fisk, C. Hertzog, S.N. Nair, W.A. Rogers, J. Sharit, Factors predicting the use of technology: findings from the center for research and education on aging and technology enhancement (create), Psychology and Aging 21 (2) (2006) 333–352.
[17] D. Flynn, P. Gregory, H. Makki, M. Gabbay, Expectations and experiences of eHealth in primary care: A qualitative practice-based investigation, International Journal of Medical Informatics 78 (9) (2009) 588–604.
[18] D.P. Lorence, H. Park, New technology and old habits: the role of age as a technology chasm, Technology and Health Care 14 (2) (2006) 91–96.
[19] C.W. Phang, J. Sutanto, A. Kankanhalli, Y. Li, B.C.Y. Tan, H.H. Teo, Senior citizens' acceptance of information systems: a study in the context of e-Government services, IEEE Transactions on Engineering Management 53 (4) (2006) 555–569.
[20] C.E. Koop, A personal role in health care reform, American Journal of Public Health 85 (6) (1995) 759–760.
[21] V. Strecher, Internet methods for delivering behavioral and health-related interventions (eHealth), Annual Review of Clinical Psychology 3 (1) (2007) 53–76.
[22] S.C. Porter, Z. Cai, W. Gribbons, D.A. Goldmann, I.S. Kohane, The asthma kiosk: a patient-centered technology for collaborative decision support in the emergency department, Journal of the American Medical Informatics Association 11 (6) (2004) 458–467.
[23] M.A. Diefenbach, B.P. Butz, A multimedia interactive education system for prostate cancer patients: development and preliminary evaluation, Journal of Medical Internet Research 6 (1) (2004) pe3.
[24] A. Dozet, C.H. Lyttkens, P. Nystedt, Health care for the elderly: two cases of technology diffusion, Social Science & Medicine 54 (1) (2002) 49–64.
[25] N. Miller, E.M. Lacroix, J.E.B. Backus, MEDLINEplus: building and maintaining the National Library of Medicine's consumer health Web service, Bulletin of the Medical Library Association 88 (1) (2000) 11–17.
[26] U. Topacan, N. Basoglu, T.U. Daim, Health Information Service Adoption: Case of Telemedicine, HICSS, 2009.
[27] R. Steele, A. Lo, C. Secombe, Y.K. Wong, Elderly persons' perception and acceptance of using wireless sensor networks to assist healthcare, International Journal of Medical Informatics 78 (12) (2009) 788–801.
[28] L. Savolainen, E. Hanson, L. Magnusson, T. Gustavsson, An Internet-based videoconferencing system for supporting frail elderly people and their carers, Journal of Telemedicine and Telecare 14 (2) (2008) 79–82.
[29] J.D. Piette, E. Kerr, C. Richardson, M. Heisler, Technology for diabetes care and evaluation in the veterans health administration: veterans affairs research on health information technologies for diabetes self-management support, Journal of Diabetes Science and Technology 2 (1) (2008) 4–6.

[30] J.M. Corchado, J. Bajo, Y. de Paz, D.I. Tapia, Intelligent environment for monitoring Alzheimer patients, agent technology for health care, Decision Support Systems 44 (2) (2008) 382–396.
[31] V. Rialle, F. Duchene, N. Noury, L. Bajolle, J. Demongeot, Health “smart” home: information technology for patients at home, Telemedicine Journal and E-Health 8 (4) (2002) 395–409.
[32] W.C. Mann, K.J. Ottenbacher, L. Fraas, M. Tomita, C.V. Granger, 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) (1999) 210–217.
[33] Y.M. Chae, J. Heon Lee, S. Hee Ho, H. Ja Kim, K. Hong Jun, J. Uk Won, Patient satisfaction with telemedicine in home health services for the elderly, International Journal of Medical Informatics 61 (2–3) (2001) 167–173.
[34] I. Ajzen, The theory of planned behavior, Organizational Behavior and Human Decision Processes 50 (2) (1991) 179–211.
[35] V. Venkatesh, M.G. Morris, F.D. Davis, User acceptance of information technology: toward a unified view, MIS Quarterly 27 (3) (2003) 425–478.
[36] F. Davis, Perceived usefulness perceived ease of use and user acceptance of information technology, MIS Quarterly 13 (3) (1989) 319–339.
[37] A Venkatesh, theoretical extension of the technology acceptance model: Four longitudinal field studies, Management Science 46 (2) (2000) 186–204.
[38] R. Hill, P. Beynon-Davies, M.D. Williams, Older people and internet engagement, Information Technology & People 21 (3) (2008) p244.
[39] K. Renaud, J. van Biljon, Predicting technology acceptance and adoption by the elderly: a qualitative study, in: Proceedings of the 2008 annual research conference of the South African Institute of Computer Scientists and Information Technologists on IT research in developing countries: riding the wave of technology, ACM, Wilderness, South Africa, 2008.
[40] M. Hough, A. Kobylanski, Increasing elder consumer interactions with information technology, The Journal of Consumer Marketing 26 (1) (2009) 39.
[41] P. Yu, H. Li, M.-P. Gagnon, Health IT acceptance factors in long-term care facilities: A cross-sectional survey, International Journal of Medical Informatics 78 (4) (2009) 219–229.
[42] C.K.L. Or, B.-T. Karsh, A systematic review of patient acceptance of consumer health information technology, Journal of the American Medical Informatics Association 16 (4) (2009) 550–560.
[43] M.G. Morris, V. Venkatesh, Age differences in technology adoption decisions: Implications for a changing work force, Personnel Psychology 53 (2) (2000) 375.
[44] N. Selwyn, S. Gorard, J. Furlong, Whose internet is it anyway?: Exploring adults’ (non)use of the internet in everyday life, European Journal of Communication 20 (1) (2005) 5–26.
[45] J.G. Jeannot, F. Froehlich, V. Wietlisbach, B. Burnand, O. Terraz, J.P. Vader, Patient use of the Internet for health care information in Switzerland, Swiss Medical Weekly 134 (21–22) (2004) 307–312.
[46] R.W. Millard, P.A. Fintak, Use of the Internet by patients with chronic illness, Disease Management & Health Outcomes 10 (2002) 187–194.
[47] Y.M. Chae, H.J. Park, J.G. Cho, G.D. Hong, K.-A. Cheon, The reliability and acceptability of telemedicine for patients with schizophrenia in Korea, Journal of Telemedicine and Telecare 6 (2) (2000) 83–90.
[48] L. Magnusson, E. Hanson, M. Borg, A literature review study of Information and Communication Technology as a support for frail older people living at home and their family carers, Technology & Disability 16 (4) (2004) 223–235.
[49] Nakamura, The effectiveness of videophones in home healthcare for the elderly, Medical Care 37 (2) (1999) 117–125.
[50] V. Stanford, Using pervasive computing to deliver elder care, IEEE Pervasive Computing (January–March) (2002) 10–13.
[51] V. Vimarlund, N.-G. Olve, Economic analyses for ICT in elderly healthcare: questions and challenges, Health Informatics Journal 11 (4) (2005) 309–321.
[52] M. Weiner, C.M. Callahan, W.M. Tierney, J.M. Overhage, B. Mamlin, P.R. Dexter, C.J. McDonald, Using information technology to improve the health care of older adults, Annals of Internal Medicine 139 (5 Pt 2) (2003) 430–436.
[53] S. Timmermann, The role of information technology in older adult learning, in learning: meeting the challanges of older adulthood, in: J.C. Fisher, M.A. Wolf (Eds.), New Directions for Adult and Continuing Education, Jossey-Bass, San Francisco, CA, 1998.
[54] L.S. Evangelista, A. Stromberg, C. Westlake, A. Ter-Galstanyan, N. Anderson, K. Dracup, Developing a web-based education and counseling program for heart failure patients, Progress in Cardiovascular Nursing 21 (4) (2006) 196–201.
[55] W.A. Rogers, A.D. Fisk, Cognitive support for elders through technology, Generations 30 (2) (2006) 38–43.
[56] G. Murdock, Debating digital divides, European Journal of Communication 17 (3) (2002) 385–390.
[57] A.G. Wilhelm, Democracy in the Digital Age: Challenges to Political Life in Cyberspace, Routledge, 2000.
[58] P.D. Alison, Logistic Regression Using the SAS System, SAS Institute, Cary, NC, 1999.
[59] A. Diamantopoulos, J.A. Siguaw, Formative versus reflective indicators in organizational measure development: a comparison and empirical illustration, British Journal of Management 17 (4) (2006) 263–282.