Gerontechnology acceptance by older Hong Kong people

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Purpose Technology develops at tremendous speed and its impact on our daily life is immense. However, studies have found that older adults are less likely to use technologies than younger people. The purpose of this study was to investigate the gerontechnology acceptance by the older population in Hong Kong. Acceptance was examined in terms of attitude and usage behaviour. **Method** Using extended Technology Acceptance Model (TAM) which incorporates health abilities and quality of life constructs, we investigated the contributing factors to the use of general gerontechnology by older adults in Hong Kong. Usage behaviour was measured in terms of degree and domains of use. Data in this study were collected at six centres for the elderly in Hong Kong through a questionnaire survey administrated by a structural interview approach. Items in the questionnaire were developed based on the previous research. **Results & Discussion** A total of 104 seniors, aged between 60 and 91, participated in the study. The Statistical Package for the Social Sciences software was used to analyze the data. The results show that basic technologies such as television and mobile phones had a high level of adoption by the respondents. However, the usage rate of high technology products, like health monitoring system and telemedicine was very low. Generally, older adults had a positive attitude towards gerontechnology, but they thought technological products and services were difficult to use and expensive. Multiple regression results indicated that older adults who were younger, females, better educated, and had higher incomes were more likely to use gerontechnology. Usefulness, ease of use, attitude, and behavioural intention were found to have no direct effects on actual usage. Mobility was negatively related to usage, whereas health satisfaction and participation in social activities increased usage. Implications and suggestions of this study are discussed.

Keywords: Communication & governance, technology acceptance and usage, Hong Kong

INTRODUCTION

Technology develops at a tremendous rate today and its impact on daily life is immense. Gerontechnology aims to apply technology to deal with problems and difficulties arising from ageing so as to give older people the chance to lead lives that are healthier, more independent and more socially engaged on a continuing basis[1]. The emphasis in gerontechnology is on creating innovative technologies to improve functional capabilities and to compensate for declining physical abilities for the ageing population. Studies have found that although many older people have positive attitudes towards technology, the usage rates for technologies like mobile phones and computers by the seniors are still low[2-4].

A lot of research has been done in America and Europe on various aspects of gerontechnology, some of it looking, for example, into the attitudes of older people towards different kinds of technologies like information and communication technology, assistive technology, health technology, and so forth[4-6]. However, very few similar studies have been conducted in China, even though it has been shown that people from different backgrounds are likely to have different attitudes towards acceptance of technology[7]. Several cross-culture studies have demonstrated that people from different cultures have different perceptions and uses of technologies[8-10]. It seems very likely then that, due to the many variations in geography, society, and politics between Asia, Europe and America, the usage and perceptions of technology by older adults will be different across the corresponding cultures. A study by Sun and Zhang[11] has confirmed that cultural background could be a constraint affecting the behavioral intention of an individual with regard to technology usage. Currently, most studies on usage of technology by older people have been carried out in Europe and America, but as yet Asian countries, with a large percentage of the older population of the world, have not been widely explored[12]. It is not known to what extent the findings for populations in developed countries can be generalized to the older populations in developing countries. As a result, research aimed at investigating the usage and acceptance of technology by older people in China will be valuable since China accounts for a large proportion of the older population of the world[13]. Technological products and services can be categorized in such terms as, operating difficulties, functionalities and intended uses, etc. Previous research on technology and the older population has generally focused on specific kinds of technology, especially

the communication and assistive technologies in the home. Other categories, such as personal mobility and transportation, and education and recreation have been largely neglected[14,15].

In order to fill in some of the gaps in the research, this study is directed at examining the acceptance of gerontechnology products and services by older people in Hong Kong. It aimed to find out: (1) the usage rates of different kinds of technological products and services among older people in Hong Kong; and, (2) the factors that influence the acceptance of gerontechnology by older people in Hong Kong. It is hope that this study on the ageing population in Hong Kong will act as a stimulus and basis for further comparative studies in China and other Asia countries.

RESEARCH FRAMEWORK
TAM

Technology acceptance has been described as "the approval, favorable reception and ongoing use of newly introduced devices and systems"[16]. When investigating the acceptance and usage of a technological product or service, the Technology Acceptance Model (TAM) developed by Davis[17] is the most widely used. The TAM was originally designed to forecast the acceptance of information technology. It states that usage behavior is predicted by intention to use (BI) which is dependent on perceived usefulness (PU) and attitude towards using (AT), and attitude is in turn determined by perceived usefulness (PU) and perceived ease of use (PEOU). PU was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" and PEOU was defined as "the degree to which a person believes that using a particular system would be free of effort."

The TAM has been widely used to investigate user adoption of the Internet[3,18,19], mobile phones[20,21], assistive or health technologies[22,23], and so on. Several meta-analysis studies have proved TAM to be the most-used, powerful and robust predictive model for technology usage[24-26]. For example, King and He[27] performed over 12,000 investigations within 88 studies of the TAM and concluded that the measurement variables in TAM were reliable and could be utilized in different contexts.

Although the TAM exists as a reliable acceptance theory, it suffers from inadequate explanatory power since different contexts and factors will affect the validity of the constructs in TAM[11]. Therefore, it has been suggested that more factors should be incorporated into the TAM when measuring user acceptance of technologies. A number of studies have shown the effectiveness of incorporating moderating factors to increase the explanatory power of TAM. Important among those factors are social norms[28-30], trust[31], compatibility[32], and self-efficacy[30].

However, current TAM studies have not considered age-specific factors when examining acceptance of technology by older populations. It is known that with ageing comes related deterioration of physiological and psychological abilities, which will inevitably affect ability to use technology products and services[33,34]. For instance, decreases in vision and hearing are very likely to hinder seniors in using equipment and technologies that rely on visual and auditory information transfer. Older adults often experience deterioration of muscular dexterity and control, which may cause difficulties when operating small buttons and more complex controls. Older user also requires a longer time to process information. As age increases, memory function decreases, in particularly short-term memory, and this can affect daily living a great deal[34]. Older adults may find a new technology hard to learn because their age related memory decline will have widespread effects on their ability to acquire and store new knowledge and skills[35]. However, previous studies have not given much consideration to age-related health and associated abilities when examining acceptance of technology by the ageing population. This study intends to make progress in overcoming this omission by including age-related factors, in terms of quality of life and health abilities, in TAM.

To cope well with ageing it is important to: maintain physical, cognitive and social activities; live independently in a manner of his/her own choosing; and enjoy a high level of quality of life[36]. Social interaction, life satisfaction and well-being are significantly related to successful ageing. The World Health Organization (WHO) defines quality of life as "individuals' perceptions of their position in life in the background of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns"[37]. Quality of life includes domains of physical health, psychological well-being, social and interpersonal relationships, environmental conditions and spiritual commitment. In this study, quality of life is comprised of living environment, satisfaction with financial and life situation, while health abilities are taken to mean those things that are greatly affected by general health, like satisfaction with health condition, and ability to move, learn and participate in social activities. It is envisaged that quality of life and health abilities will influence actual usage of gerontechnology by older people in Hong Kong.

Hypothesis development
Based on the theoretical framework, the following hypotheses are proposed:
H1.1 - H1.3: Perceived usefulness will be positively associated with attitude, behavioral intention and usage.

H2.1 and H2.2: Perceived ease of use will be positively associated with attitude and usage.

H3.1 and H3.2: Attitude toward using will be positively associated with behavioral intention and usage.

H4: Behavioral intention will positively predict usage.

H5.1 - H5.3: The quality of life constructs, i.e., living environment, financial satisfaction and life satisfaction will have positive influences on usage.

H6.1 - H6.4: Health abilities are; health satisfaction, movement ability, learning ability and participation in social activities; and will have a positive impact on usage.

METHODOLOGY

Participants

The population in this study was Hong Kong Chinese people aged 60 and above. The samples were generated using convenience sampling from six Neighborhood Elderly Centres and District Elderly Community Centres in Hong Kong. 104 respondents comprising of 26 males and 78 females participated in the study, with ages ranging from 60 to 91. The majority of the respondents were female (75.0 %), in the age bracket 70 to 79 (68.3 %), living with children and/or with spouse (41.3 %), retired (98.1 %), with no education or primary education or below (61.6 %), living in private housing (54.8 %) and with a monthly income between HKD 4000 to 6999 (34.6 %). Table 1 summarizes the demographic characteristics of the respondents.

Table 1. Demographic characteristics of the respondents (n = 104)

Demographic Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	26	25.0
Female	78	75.0
Age		
60-69 years old	11	10.6
70-79 years old	71	68.3
80 years old or above	22	21.2
Status of household members		
Living alone	40	38.5
With children only/With children and spouse	43	41.3
With spouse only	21	20.2
Employment status		
Full time	2	1.9
Retired	102	98.1
Level of education		
Uneducated	32	30.8
Primary or below	32	30.8
Form 1 to 3 (Secondary education)	23	22.1
Form 4 to 5 (Senior Secondary)	8	7.7
Form 6 to 7 (Matriculation course)	7	6.7
Associate or Diploma	2	1.9
Occupation before retirement		
Self-employed	14	13.5

Table 1. Demographic characteristics of the respondents (n = 104)

Demographic Characteristics	Frequency (n)	Percentage (%)
Professional/Assistance Professional	14	13.5
Office worker	6	5.8
Sales	3	2.9
Engineer operator	7	6.7
Unskilled worker	60	57.7
Type of Housing		
Public rental housing	29	27.9
Home ownership/sandwich class housing scheme estate	15	14.4
Private housing	57	54.8
House tenant	1	1.0
Room tenant	2	1.9
Monthly Income ($HKD)		
No income	1	1.0
1000 below	7	6.7
1000 to 1999	23	22.1
2000 to 3999	27	26.0
4000 to 6999	36	34.6
7000 to 9999	7	6.7
10000 to 14999	3	2.9

Procedure

A survey questionnaire was administrated to the participants though a structured interview which was done in May and June 2010 in six centres for the seniors in Hong Kong. Since the data collection procedure was done by trained interviewers, all the questionnaires were collected without missing answers.

Measurement

Technology acceptance was examined in terms of attitude and usage behaviour. The measurements were developed based on previous TAM research and comprised of four parts: 1) use of technology products and services; 2) perceptions and attitude about general technology products and services; 3) quality of life and health abilities; and 4) demographic information.

Use of gerontechnology was measured in terms of degree and domains of use. Technology products and services were categorized into five domains as suggested by Fozard[15], which include housing and daily living; communication and governance; personal mobility and transportation; health and self esteem; and work, recreation and self-fulfillment. A total of 22 technology products and services were listed and the degree of use was measured by asking the respondents whether they: 1) have been using the technology product/service; 2) had heard of the technology product/service but not used in the past six months; 3) had not heard of the technology/service. The Cronbach's alpha value for this scale was 0.704.

Perception and acceptance of gerontechnology was based on the TAM, which includes the constructs of

perceived usefulness, perceived ease of use, behavioral intention and attitude. Perceived usefulness (PU) was defined as the users feeling of improved performance when they use the technology[23,38]. Perceived ease of use was defined as the strength of one's belief that interacting with the technology product/service would be free of effort. Behavioral intention was measured using a three-item scale. All constructs were measured using a 10-point Likert scale indicating respondents' agreement with the description given by the related sentence. The Cronbach's alpha value for this scale was 0.955.

The measurement of the quality of life consisted of self-rated satisfaction with their living environment, financial condition, and satisfaction with life overall. Health abilities were measured by overall health condition, movement satisfaction, learning ability and the frequency of participating in different social activities. The respondents rated their levels of satisfaction on a 10-point scale. The reliabilities of the scales of quality of life and health abilities were 0.887 and 0.738 respectively.

Pilot study

Before the data collection process, a pilot study was conducted in order to ensure the questions were suitable in terms of difficulty, comprehension, length and significance. The questionnaire was administrated to a sample of five respondents selected by convenience sampling in an elderly centre. The test setting mirrored the planned survey test proper setting as closely as possible. The survey instrument was revised based on the results of the pilot study in terms of modifying the wordings, adding/deleting questions, etc.

Data analysis

The Statistical Package for the Social Sciences (SPSS) was used to describe and analyze data for this study. A confidence level of 95% was chosen as the criterion for testing the hypotheses.

RESULTS

Use of gerontechnology

In this study, the respondents' use of different types of technology was investigated. The result is shown in table 2. When gerontechnology products or services were categorized into survival, basic, and high technology; there were clearly different adoption rates between the three types of technology. The adoption rates decreased gradually from survival to basic technology and drastically for high technology.

For products/services in the survival level category, all of the respondents were or had been using television (100%) and majority of them were or had been using the kitchen stove (96.2%), reading glasses (75%), exercise equipments (74%), and walking stick (60.6%). The handle trolley shopping bag had been

adopted at a relatively lower rate (21.2%), which might be because the older people did not need purchasing a lot of domestic goods and products and they could carry them without the help of the trolley bag.

Table 2. Responses about usage of technology products/services (n=104)

Products/services	Not heard of (%)	Heard of (%)	Used or using (%)
Survival technology level			
Television	0.0	0.0	100.0
Kitchen stove	0.0	3.8	96.2
Reading glasses	0.0	25.0	75.0
Exercise equipment	0.0	26.0	74.0
Walking stick	0.0	39.4	60.6
Handle trolley shopping bag	0.0	78.8	21.2
Basic technology level			
ATM	4.8	78.8	16.3
Combination lock	2.9	41.3	55.8
Digital camera	1.0	76.9	22.1
Massage chair/equipment	0.0	78.8	21.2
DVD/VCD/CD player	0.0	45.2	54.8
Mobile phone	0.0	23.1	76.9
Security alarm	0.0	58.7	41.3
Public transport	0.0	15.4	84.6
High technology level			
Home Automation System	62.5	37.5	0.0
Home health monitoring system	71.2	28.8	0.0
Touch screen mobile phone	59.6	40.4	0.0
GPS	61.5	38.5	0.0
Telemedicine	75.0	25.0	0.0
PDA	50.0	50.0	0.0
Network communication	26.9	71.2	1.9
Internet/E-Learning/Computer games	12.5	50.0	37.5

For the products/services in the basic technology category, some of the products/services were or had been adopted by the respondents, such as public transport (84.6%), mobile phone (76.9%), DVD/VCD/CD player (55.8%), combination lock (55.8%), and security alarm (41.3%). While the digital camera (22.1%), massage chair/equipment (21.2%) and automatic teller machine (ATM) (16.3%) received much lower adoption rates but almost all of the respondents had heard of them. It may be seen that mobile phones had been widely adopted by the seniors for communicating with their children, spouse and friends. Many of the respondents reported that their mobile phones were bought by their children because of its convenience as a means of keeping in touch.

When looking at the result for high technology products and services, it is apparent that the respondents did not use those products/services, with the excep-

tion of internet/e-Learning/computer games which were adopted by approximately one-third of the respondents (37.5%). The usage rates for other high technology products and services like home automation system, personal digital assistant (PDA), and telemedicine were zero. Moreover, more than 60% of the respondents had not even heard of home automation system, home health monitoring system, GPS and telemedicine.

In general, the respondents had accepted and used survival technologies and adopted the basic technologies to some degree. However, they were mostly unaware of or not users of high technology products/services and advances in these technologies, some of which might be of considerable benefit to them. Many of them did not have the knowledge to recognizing the potential usefulness of these products/services to improve the quality of their lives.

Predictors of acceptance of gerontechnology
A composite score was obtained by summing up all the responses on the scale of use of technology. Hierarchical regression was used to examine the factors which contribute to the use of gerontechnology by older adults in Hong Kong. The dependent variable was actual use of gerontechnology. For the first model used here, the independent demographic variables which included age, gender, education, and monthly income were entered into what is called Model 1 here (Table 3). Then, the variables from the TAM constructs, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention were added for Model 2. Finally, the constructs of quality of life and health abilities were added for Model 3, which was the most detailed model used here. The results are presented in Table 3.

The results showed that usage of gerontechnology by older adults in Hong Kong could be predicted by age, gender, education, monthly income, health satisfaction, movement ability, and participation of social activities. These factors jointly explained 80.7% of the variance in actual use of gerontechnology. Age was negatively related to use of gerontechnology, indicating older seniors used fewer technologies than younger seniors. Females were more likely to use technology than males. Education level and income were positively related to usage, which indicated that people with higher levels of education and with more monthly income would use more technologies. Moreover, the TAM constructs, that were perceived usefulness, perceived ease of use, attitude towards using, and behavioral intention, were found to have no direct influences on usage. Therefore, H1.3, H2.2, H3.2 and H4 were not supported. In the TAM, perceived usefulness and perceived ease of use were supposed to jointly de-

termine attitude towards using which then predicts usage intention. For this reason, the hierarchical regressions with the same independent variables were employed to examine the predictors of behavioral intention and attitude. It was found that perceived usefulness and ease of use positively predicted attitude towards using, which confirmed H1.1 and H2.1. Also, usefulness and attitude towards using had positively influences on the behavioral intention to use gerontechnology, and thus H1.2 and H3.1 were supported.

Quality of life factors, i.e. living environment, financial satisfaction and life satisfaction did not directly affect usage. Therefore, H5.1, H5.2 and H5.3 were not supported. Health satisfaction and social activities participation were found to positively predict usage, which confirmed H6.1 and H6.4. Older adults who had better health and frequently participated in social activities were more likely to use technologies. Contrary to the expectation of H6.2, movement ability decreased usage, which indicated that people with poor movement ability used more technologies. With regards to learning ability, it did not have direct relationship with usage and thus H6.3 was not supported.

Table 3. Hierarchical regression on usage of gerontechnology

Independent variables	Model1 (β)	Model2 (β)	Model3 (β)
Age	-0.404***	-0.338***	-0.399***
Gender	0.371***	0.322***	0.291***
Education	0.502***	0.406***	0.302***
Monthly income	0.322***	0.228***	0.189***
Perceived usefulness		0.050	0.006
Perceived ease of use		-0.029	-0.120
Attitude toward using		0.204	0.199
Behavioral intention		0.047	-0.123
Living environments			0.014
Financial satisfaction			0.109
Life satisfaction			-0.054
Learning ability			-0.074
Health satisfaction			0.426***
Movement ability			-0.148*
Social activities			0.291***
F-value	41.045***	23.987***	24.600***
R^2	0.624	0.669	0.807

Verbal responses
Since the structured interview technique was adopted, the opinions and feelings expressed by the respondents during the interview were collected. Table 4 shows the opinions and reasons given by the respondents for not adopting a particular kind of technology product/service. These opinions provided an

explanation for the reason that some kinds of technology products/services available nowadays were not accepted by older people in Hong Kong. According to the responses, it may be seen that cost and health problems were major barriers to the use of gerontechnology by the elderly.

Table 4. Reasons expressed by respondents on not adopting technology products/services

Technology products/services	Reasons for not adopting them
Computer/ Internet	Too old to learn/ cannot memorize the operating procedures Too difficult to operate Illiterate/ do not know English Too expensive
Mobile phone	Too troublesome to pay the phone bills every month
Message chair	Too expensive
Automatic teller machine (ATM)	Could not see the words on the monitor clearly Could not remember the password and fear for the card being confiscated by ATM
Security alarm	The monthly fee was too expensive Not necessary since living with spouse/children
Public transport	Health condition/ mobility was too poor for traveling
Touch screen mobile phone	Too difficult to control Too expensive

DISCUSSION
Use of gerontechnology
For this study the Technology Acceptance Model (TAM) was expanded to incorporate health abilities and quality of life constructs. Using expanded models, the factors which contribute to the use of general gerontechnology by older adults in Hong Kong were investigated. Data in this study were collected in six elderly centres in Hong Kong through a questionnaire survey administrated though a structured interview approach. One hundred and four respondents aged 60 years and older participated in this study.

It was found that survival technologies have particularly high adoption rates, which means the survival level technologies are already embraced by many seniors in Hong Kong. Moreover, basic level technologies were quite widely known and had a moderate adoption rate. The high usage rates among survival and basic technologies could be due to the fact that they had been in use for a relatively long time in society. When a new technology product/service is introduced into a market, it is often identified as high-tech (e.g. mobile phone in 80s) and is expensive. However, as time goes by, the technology product/service gradually becomes universal, it is no longer high-tech, the price comes down, and the general public have greater access to the technology. In this research, survival technologies had a particular high adoption rate which may be because many

of the survival technologies are related to housing and daily living (e.g. stove, reading glasses), and they are common electrical appliance. The prices of the survival technologies are reasonable and affordable for older users.

For basic technologies, the adoption rates varied among different products/services. For example, Automatic Teller Machine (ATM) had quite a low adoption rate. Many of the respondents reported that they had used ATMs, but they had bad experiences with them. Respondents said that they found it hard to see the words or comprehend the meaning of the messages shown on the monitor due to visual problems or illiteracy. A majority of the respondents expressed concern about safety and security problems. They claimed that they have had a card confiscated by an ATM and this caused them fear of using an ATM again. This concern about safety and security issues has also been reported in a previous study[20].

The findings showed that a majority of the respondents had used or were using mobile phones. This widespread use may be attributed to the relatively low price of mobile phones nowadays due to the rapid advances and spread of mobile technology. Previous research has shown that for seniors, ease of use and price are the factors that concern them most when purchasing a mobile phone[2,40]. Also, local marketing has exploited the seniors' market by introducing mobile phones with simple, useful functions like a safety alarm, and prices are reasonable which suits the budget of seniors. Local telecommunication companies also have introduced special lower price plans for the aged.

For high technologies the adoption rate was much lower than for survival and basic technologies. High technologies are by definition involve innovation and the users often have to exert considerable effort to learn new skills to use new products/services. As suggested by Bouma et al.[14], seniors often have difficulty in adopting new technologies and learning new skills because they become accustomed to a routine way of life over a long time and they may not perceive these high technologies to be useful. Also, when they were young the rate of change was much slower and people did not expect to adopt some new technology every few years. Furthermore, the aged experience deterioration of perceptual and cognitive abilities which can greatly affect their performance and interaction with equipment. The ability to understand things and to learn decrease with age, and information processing time is longer, all of which creates extra burdens and barriers to taking up new technologies.

Perceptions and acceptance towards technology
The perception and acceptance of older people with regard to gerontechnology was measured using the Technology Acceptance Model (TAM). It was found

that age, gender, education level, and income directly influenced the use of gerontechnology. This result is consistent with previous studies showing that increasing age was associated with decreased use of gerontechnology[18,41,42]. Education level and income positively related to use of technology. People with higher education and income had more chances to use gerontechnology. An interest finding was that females were more likely to use gerontechnology than males.

Perceived usefulness, perceived ease of use, behavioral intention, attitude towards technology, and usage behavior for older people were investigated in this study. Results indicated that older adults in Hong Kong generally have a positive view towards technology. Although the respondents perceived technology as useful and had positive attitudes, they thought that technology products/services are difficult to operate.

In agreement the expectations from TAM, in this study, perceived usefulness and perceived ease of use were found to be predictors of attitude towards using gerontechnology and this had a positive effect on behavioral intention to use gerontechnology. McCreadie and Tinker[22] suggested that the "felt need", i.e., the individual feeling that the technology is useful, is central to technology adoption. Consensus among researchers exists that older people would accept and use of new technologies if they believed and realized that those technologies might be used to improve their lives and satisfy their needs[2,43]. Perceived ease of use is also an indicator of attitude. Previous studies have indicated that older people are more likely to accept technologies that are easy to understand and have a simple interface design[5,18]. However, outside the expectations here were the results that perceived usefulness, perceived ease of use and attitude towards use were not directly related to actual use. The direct relationship expected between behavioral intention and actual usage was also not found, and this result differs from the findings of previous research[29,44]. Turner[44] performed a systematic literature review of 79 relevant empirical studies in 73 articles using vote-counting meta-analysis, and found that perceived usefulness and perceived ease of use were not so likely to predict actual usage, and this is consistent with our finding. The non-significant relationship found here between behavioral intention and actual usage might be due to some ambiguity in the questions, in that, the measures of intention of use and actual usage did not specified the type of technology. The self-reported usage may also be another reason for the inconsistency. Self-reported usage can be subject to method bias, and this will distort the result which might, therefore, not represent actual usage behavior[45].

This study extended previous work by considering the effects of quality of life and health abilities for the prediction of acceptance of technology by older adults. The results indicated that when demographic variables and TAM construct were controlled, quality of life constructs, i.e., living environment, financial satisfaction and life satisfaction were not direct determinants of usage.

Health satisfaction was positively associated with usage. It is known that ageing brings with it changes in perception, cognition, movement, and psychosocial functioning[33,34], and these changes may influence an older person's needs and his or her capabilities to use a technology or technical devices. People with poor health might find that interaction with technology is not easy for them. Age related visual and hearing impairments may influence the ease with which these technologies are used. Most electronic appliances like DVD players are equipped with small digital displays, and older people with poor visual acuity will have difficulty in reading message from such appliances. Previous study has found that older adults with physical difficulties in vision, hearing and motion used fewer technologies than people with good health[46,47]. It has also been shown that people with higher levels of crystallized and fluid intelligence used a greater variety of different types of technology[48]. Furthermore, the decline in perception and cognition abilities in older people may decrease their performance when trying to use a particular technology. For example, in a web usability study, Chadwiek-Dias[49] found that older users (55 years or older) took a longer time to finish tasks, had lower task success rates, and fewer mouse clicks per minute than younger adults. This is consistent with our finding that people with better health were more likely to use technology.

The results here show that participation in social activities may increase the use of technology. Older adults who take part in social activities are likely to receive more new information on technology products/services and share their usage experience with others. Beside, when they experience difficulty in using a technology, their peers may be able to provide help for them and this can make their attitude towards acceptance of technology generally more positive. An active lifestyle and participation of social activities may increase willingness to learn about new things and perhaps be more accepting of new advances in technology[50]. Social factors also contribute to the development of the necessary motivation to learn about and to use technology[51].

Contrary to expectation, movement ability deceased actual usage. A possible explanation might be that, included in the measurements here were mobility technologies, such as walking stick, trolley bags and mobile phones, which were mainly used to compensate for lack of mobility. Also, technologies like tele-

phones, computers and online-shopping can benefit people with poor movement ability by reducing the need or frequency for trips out. Therefore, people with less mobility might benefit more by use of those technologies.

Other factors

In this study, some additional factors affecting the acceptance of technology by older users were elicited through the interviews. Cost was found to be related to use of technology. As suggested by Mallenius[40], the price of a product/service is an important consideration for seniors. The cost of a product includes the first costs (i.e. purchase cost) and the long term cost such as maintenance and repair expenditure. The cost of purchasing new technologies and the monthly service fee of maintaining the services (e.g. security alarm) could be barriers to some older users.

The respondents said that they often feel anxiety about using technology and are afraid of making mistakes they could not correct. Older adults tend to worry about handling new technologies and avoid them because of the fear of making mistakes. For instance, respondents reported that they were frightened that they would forget their password when using an ATM. They were also afraid that they might misuse and therefore damage domestic appliances.

CONTRIBUTIONS AND LIMITATIONS

This study examined the factors affecting acceptance and use gerontechnology by the ageing population in Hong Kong. It aimed to increase understanding about the design and effectiveness of technology to improve the quality of life for seniors. The present study has some theoretical and practical contributions and intends to raise the awareness of technology impacts on the ageing population in Hong Kong.

It was found that health satisfaction positively predicts actual usage of gerontechnology. This result suggests that designers should determine whether older users are able to withstand the physical and psychological demands made by the product/service they will use. For example, with age comes a gradual and inevitable decline in physiological functioning particularly in sensory systems which include vision, hearing, and thermal comfort. Other problems that older people often encounter are difficulty in movement and decreased physical strength and endurance. Gerontechnology products have to be usable by the targeted users to serve its stated purposes in the intended environment. The strengths and limitations of the targeted users should be accommodated and the users should feel little or no fatigue or discomfort when they use gerontechnology.

The respondents here found technology products/services difficult to use. This may be because product designers do not consider the needs and characteristics of the ageing population in product design. The needs of older consumers are rarely considered and basic human factors are often overlooked since product developers tend to create products with the best attributes and functionalities of the product in mind, not the needs of the user. If developers put more emphasis on basic attributes when designing a product/service, it may give them a good opportunity to open their market for the aged who are rapidly increasing as a proportion of the population in many countries. This could be done by a user based assessment approach in the early stages of design.

The cost of the gerontechnology products and services was a major concern for older users. Moreover, the time required to obtain, set up and learn the usage skills for a product/service, are also costs for the user. These costs associated with a product have to be justified by its performance and benefits. This is vital because many of older people do not have strong financial support. Governments and developers may help here by providing some preferential arrangements, such as subsidizing technology usage activities, or establishing more facilities in communities and public locations, in order to encourage older people to make greater use of gerontechnology.

In this study, there were several limitations. Firstly, the survey relied on a convenience sample. Therefore, any generalization of the results should be done with caution. Further study may use random sampling with a larger sample size. Secondly, this research investigated a generic point of view on technology acceptance. It did not focus on the acceptance of a particular technology product/service. Further studies could employ a more specific approach. Thirdly, self-reported usage was employed and further study may consider more objective measures.

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