

Understanding older individuals' emotional responses to new technology associated with healthy lifestyle choice

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Abstract:

This study explored the perceptions and emotions of older adults when they interact with technology within the context of their personal environment. In-depth interviews and product evaluation and assessment techniques were used to assess key elements of diffusion of innovation theory. Three major themes emerged from the analysis process: (1) *Simple is Better*, (2) *Complex Works for Some*, and (3) *I Do Not Need This - Why Should I Care?* Although older adults have long been regarded as a homogeneous group in relation to technology adoption, the result of this study suggested the idea that they may be more heterogeneous group. For these reason, it is very important to acquire the authentic knowledge about older adults' life and experience. We hope that insights gained from this study will contribute to motivate older adults' healthy lifestyle and quality of life.

Key Words: Older Adults, Healthy Lifestyle Choice, Technology Adoption, Diffusion of Innovation

Introduction

The world's population is aging as a result of improvements in public health and hygiene, technological developments, and advances in health care (Ahn, Beamish, & Goss, 2008). The population aged 65 and over is one of the fastest growing age groups. According to U.S. Census Bureau, older adults aged 65 and over will soon outnumber children under the age of 5. Moreover, the world population aged 80 and over will more than double between the years 2008 and 2040 (2008 Census Data, 2009).

As the number of older adults increases and life expectancy gets longer there is a growing interest regarding the effect of healthy lifestyles on quality of life in the older adult population. Quality of life is generally influenced by the combination of a person's physical condition, self-perceptions, observable behaviors, and life circumstances (Hooyman & Kiyak, 2008). Quality of life also depends on the emotional interpretation and subjectivity of the individual (Xavier, Ferraz, Marc, Escosteguy, & Moriguchi, 2003). Thus, quality of life is closely related to healthy lifestyle choices (Lowry, 2010). A healthy lifestyle is one of the most important determinants to decrease the probability of health problems in later life (Lyons & Langille, 2000). A healthy lifestyle generally includes physical activity, healthy eating, maintaining optimal weight, moderate alcohol consumption, and not smoking (King, Mainous III, Carnemolla, & Everett, 2009).

Compelling evidence exists which shows that technologies enable older adults to be more active and to improve their quality of life. For example, activity monitoring technology, including pedometers and mobile phone applications, may help raise awareness in older adults regarding their physical activity levels (Consolvo, Everitt, Smith, & Landay, 2006). Some technologies can be a powerful and potential tool to help older adults become more physically, mentally, and socially active. Numerous studies have explored the potential role of technology to help motivate older adults to adopt a healthy lifestyle. For example, de Blok et al (2006) reported that pedometers enable older adults to accurately monitor their physical activity by helping to establish visible goals for increasing physical activity. Similarly, Hurling et al. (2007) studied the effectiveness of using internet and mobile technology to motivate older adults' healthy lifestyles. Technology use may have a positive impact on older adults' healthy aging and quality of life (Topo, 2009).

Unfortunately, only small percentages of older adults have been using new technology to improve their quality of life. For example, in 2010, only 31% of American older adults used a high speed internet connection compared with 75% of adults aged 30-49 and 63% of adults aged 50-64 years (Smith, 2010). American Association of Retired Persons (Keenan, 2009) reported that only 48% of adults aged 65 and older are currently using computers while 78% of adults aged 50-64 years use computers. Notably, older adults aged 65 and over were found to be less likely to use the internet or a computer in the future due to lack of interest. Two studies

(Smith, 2010; Adler & SeniorNet, 2006) reported that older adults were much less willing to use technology in comparison with younger adults. Thus, it is valuable to understand why many older adults appear to be indifferent to technology use and how we can help older adults to adopt these potentially useful tools. Table 1 shows recent researches associated with technology use and older adults' healthy lifestyle choice.

Table 1. Studies related to technologies motivating older adults' healthy lifestyle between 2003 and 2011

Author	Year	Technology	Result
Park and Jayaraman	2003	Wearable technology	Positive to enhance quality of life in older adults
Chumbler et al	2004	Home-telehealth	Positive to improve both IADL and ADL in older adults with chronic diseases
Intille	2004	Mobile computing devices and real time context-aware computing	Positive to motivate healthy aging
Pollack	2005	Artificial intelligent technologies including robotics and machine vision.	Positive to motivate healthy aging, and needed to understand human-machine interaction
Consolvo et al	2006	Mobile phone application (Houston)	Positive to motivate physical activity, but there were important design requirements
de Blok et al	2006	Pedometers	positive to increase physical activity in older adults
Dickinson and Gregor	2006	Computer	Positive to wellbeing in older adults
Hurling et al	2007	Internet and mobile technology	Positive to motivate healthy lifestyles in older adults
Demiris and Hensel	2008	Smart home technology	Positive to motivate healthy aging, but there were some challenges related to both technical and ethical issues
Topo	2009	General technology including computer and video conference	Positive to support older adults with dementia and their family
Jung et al	2009	Nintendo Wii	Positive to overall wellbeing in older adults
Wollersheim et al	2010	Nintendo Wii	Positive to improve sense of physical, social, and psychological wellbeing in older women
de Bruin et al	2010	Interactive video games, such as Nintendo Wii, Sony PlayStation, and Microsoft Xbox	Positive to increase motor control including balance and walking pattern in older adults
Fukuda	2011	Potable game system	Positive to older adults' everyday life and emotion
Pilotto et al	2011	Information and communication technology (ICT)	Positive to help both Alzheimer's disease patients and their family to lead more independent and healthy lifestyles

The purpose of this study was to understand the perceptual and emotional responses of older adults towards existing and emerging technological products. More specifically, the study had two objectives. First, we focused on understanding older adults' emotions and perceptions when they encounter new technology. Second, we aimed to understand factors influencing their technological purchase decision-making.

Method

Design & Evaluation and Assessment

In this study, we used a qualitative research design, including product assessment and in-depth interviews, in order to gather rich and authentic data. The product evaluation and assessment (McDonagh, Bruseberg, & Haslam, 2002) was used to study the nature of interactions between older adults and technological devices. Five experts in the field of Kinesiology and Industrial Design determined the criteria for technology classification. According to the classification, participants were asked to examine four different technological devices. Two different types of television remote controls (simple versus complex) and two different types of pedometers (simple versus complex) were presented to the participants, one at a time. Each participant was asked to examine each item for a short period of time (5 min/product). Additionally, the reason why we chose television remote control and pedometer is that we focused their different intrinsic attribute. Generally, television remote controls are very familiar with older adults' everyday life while pedometers are not. Further, television remote controls are generally known as a technology which may promote sedentary lifestyle by utilizing watching television while pedometers may promote physical activity (Bravata et al., 2007). Based on these logical deductions, we proposed figure 1 and 2 as the product evaluation matrix.

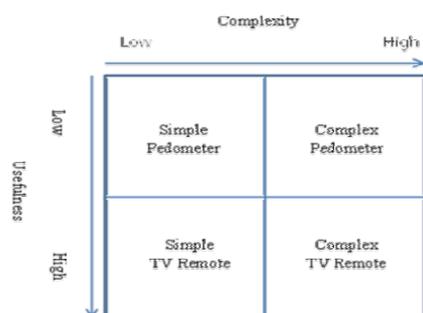


Fig. 1. Product Evaluation Matrix



Fig. 2. Actual Devices for Product Evaluation

Participants were asked to provide prompt and immediate feedback. Following the completion of the product evaluation and assessment, in-depth interviews were conducted to explore the older adults' emotional and perceptual responses toward a sample of new technological products. Figure 3 describes one of older adults participating in the product evaluation process.



Fig. 3. Product Evaluation Process

Participants

Participants were recruited from two nonprofit continuing care retirement communities in a Midwestern town in the United States. Participants were recruited by face-to-face interaction, phone contact and recommendations from facility staff and residents. A total of 20 older individuals participated in this study. The following inclusion criteria were used; (a) at least 65 years of age; (b) ambulatory; (c) no evidence of language or verbal communication deficit; (d) no evidence of mental impairment. All participants signed a consent form prior to participation in this study. This study was approved by the University of Illinois Institutional Review Board.

Data analysis

Both inductive and deductive analyses were used for interpreting and analyzing all data. Open coding, also known as line-by-line coding, was performed to identify initial phenomena and produce a list of important themes (Gorra, 2007; Strauss & Corbin, 1998). Interviews, coding and data comparison were performed repeatedly until no new themes were found and data saturation was judged to be complete (Charmaz, 2006; Gorra, 2007; Radcliffe & Lester, 2003). Once patterns, themes, and/or categories were established through inductive analysis, then confirmatory stage of analysis was performed. Both qualitative comparative and analytic induction approaches were performed to look for undiscovered phenomena within the setting.

Findings

We selected ten residents from each of the two different retirement communities. The average age of the participants in location one (LOC1) was 83.7 and the average age of the residents from location two (LOC2) was 78.9. In LOC1, there were seven participants who had attended graduate school, one participant with a bachelor's level education, one participant who graduated from a community college, and one participant with a high school diploma. In LOC2, there were three participants who had attended graduate school, one participant with a bachelor's degree, one with a community college degree, and five participants who graduated from high school. Although LOC1 residents had a relatively higher education level, examination of the interview transcripts and the themes that emerged from the interviews suggested that education was not a major factor influencing technology perceptions in this study. In total, there were five male and five female participants in both LOC1 and LOC2.

Three major themes emerged from the interviews with the participants: (1) simple is better, (2) complex works for some, and (3) I do not need this. Why should I care?

Simple is better

The first major theme that emerged in the present investigation was older adults' preference to use simple technology. Rogers (2003) has suggested that many older adults may prefer to use simple technology and this study provides qualified support for this hypothesis. In this study, most of the older adults stated that they

prefer to use simpler or older versions of technology instead of advanced versions of technology despite the potential benefits of the more advanced one. Moreover, participants who held this position often expressed skepticism and negative attitudes toward advanced or complex versions of technology. There may be several diverse reasons and factors as to why many older adults prefer to use simple or older versions of technology.

Many older residents expressed a sense of helplessness when faced with advanced or newer forms of technology, and as a result, they prefer to use simpler technologies. Due to a lack of help and easily available technical support, seniors reported feel challenged when using certain types of newer technology.

I wanted a simple life... Probably primarily I don't have anybody to help me get started... And I'm not that interested to learn it on my own...I'm never going to be cutting edge... (Male 76 LOC1)

Some residents mentioned that they prefer to use simple technology because they do not have any previous experience with advanced technology or they had prior negative experiences with advanced or complex forms of technology. Lack of previous experiences, coupled with negative previous experiences, played an important role in decreasing their positive feelings about using complex and new forms of technology. Others suggested that simple technology was more compatible with their lifestyle. Compatibility is a measure of the degree to which a new technology or new idea is perceived as fitting well with existing values in one's life (Rogers, 2003; Sanson-Fisher, 2004). One individual in this study mentioned that advanced technology did not fit into her lifestyle because she was a wife of a farmer and had not frequently been exposed to advanced forms of technology within the home environment.

I would use this one (TV remote simple). Because it's simple... I have been a farm wife all my life. I know how to run a tractor or a combine and all that kind of stuff, but this kind of stuff I don't care for...My concern is that I would mess this one up. (Female 77 LOC2)

Although she was familiar with technologies used in farming, such as tractors and combine harvesters, she had seldom been exposed to the other forms of technology in her life. As a result, she felt less comfortable around complex and advanced forms of technology and comfortable with simple things.

Some seniors reported a preference for using simple technology due to a decreased ability to learn new things. One individual stated that his mind has become dormant and that his brain is getting slower every day. As a result, he preferred simpler forms of technology. He did not want the challenge of learning how to use advanced or complex forms of technology. For example,

I would like that one (TVS) better... It would take me too long to figure out, to learn it, because my mind has become like dormant now...The brain is so much slower today than it was sixty years ago...A simple one is no challenge to my brain... (Male 80 LOC2)

Some individuals described that declines in their physical condition due to aging, negatively impacted them when learning to use new technologies. They also believed that their physical and/or mental declines might have limited their access to information about new technology. For example:

This one (TV remote complex), now I probably couldn't read it, but I can see it (TVS) better... Well, if your eyesight is good they would both be easy to use...but for me... (Female 98 LOC2)

It's just too much crapes... My mind doesn't work fast enough like it used to. My memory isn't working as good as it used to either. I guess that's part of getting old... (Male 84 LOC1)

The final reason older adults' gave for preferring simple technology was their isolation. Many older adults perceive fewer opportunities to assess the trialability and observability of newer technology. For example:

I don't have any place to find new technology... I have no way of finding somebody that has an iPhone to show me how...I don't have access...I don't have any opportunity... (Female 88 LOC1)

Complex works for some

The second major theme that emerged from the present study was the preference of some older adults' towards new and complex technology. Despite the fact that many older adults often prefer to use simple technology, there appear to be some older adults that are more comfortable with the use of advanced or complex forms of technology. In this study, older adults who were experiencing appropriate supportive circumstances sometimes chose advanced versions of technology over simpler forms. This suggests that the diffusion of innovation theory may oversimplify the relationship that older adults have with technology. Most of the older adults who held this position showed some of the characteristics of 'early adopters'. In this theme, diverse reasons and factors emerged to explain why some older adults preferred to use advanced or complex versions of technology.

Many older residents who held this position tended to see relatively more benefits of using advanced technology. *I would probably pick that one (TVC) there... Well because there are many more possibilities of things it does...Yes. This has many more possibilities of using different... (Female 84 LOC1)*

I would prefer this (Pedometer Complex)...because of the extra functions...A little more complicated because it does that much more... The functions that this one (PEC) does that this one (Pedometer simple) doesn't... (Male 84 LOC1) Some older individuals expressed their preference for advanced television remote controls because they are currently using many different media devices and would like to control all of them through the use of one remote.

This one (TVC) would be very useful... I mean this would fit with my lifestyle because it would allow me to do what I want to do when I am watching television or Netflix or whatever...

In this case, older residents who held this position may consider the compatibility of television remotes with their current needs and lifestyle. The third element explaining older adults' preference towards advanced or complex forms of technology was positive previous experiences. In this study, some individuals mentioned their positive prior experiences with advanced technology.

I am sure I can figure it (TVC) out...I can figure things out really quick. I am a retired electrician... (Male 80 LOC2)

I would use this (TVC) over that other one...because I have always liked something new. I have always wanted to try something new... I enjoy computers. (Male 83 LOC2)

These positive factors may have had an influence on their comfort level and ease of use when referring to new technology. The final explanation for why certain older individuals prefer advanced or complex forms of technology was due to the amount of support received from family members. In this study, older residents who held this position tended to use advanced technology due to support from their family.

I'm quite comfortable with technology. I use the computer...because so far I've got a helper. Our son is really a computer guru and he helped pick it out, and gives us ideas of what is good and bad. (Female 84 LOC1)

I do not need this. Why should I care?

The third major theme identified in the current study was "I do not need this. Why should I care?" This theme supports the idea that many older adults are indifferent or dislike using technology due to factors such as a lack of perceived benefits, a lack of perceived need, a lack of compatibility with current lifestyle, and a concern over cost. Older residents who held this position often chose not to use any technology simply because they did not see any benefits in using it regardless of its complexity.

a. I do not need all of these!!!

Older residents who held this position tended to reject all types of technologies. They did not want to be bothered by something new. First of all, some individual in our study expressed indifference feeling about all forms of technology. For example,

The old men don't like them... (Male 78 LOC2)

The technologies don't change for me right now...because my life has changed considerably... (Male 82 LOC2) One individual expressed frustration. He showed no inclination towards any types of technology. For example, *I'm not comfortable with trying to do things that are kind of new to me and different...I feel like I'm falling further and further behind, you know, what's happening every day. And I doubt if I'll ever catch up because I'm not interested in new technology at all. (Male 76 LOC2)*

The series of negative feelings may finally cause fear. For example,

If somebody gave me one I would be very nervous as to even start unless they stayed with me (Female 88 LOC2)

I am afraid I will mess or screw something up...I feel some risk... (Female 69 LOC1)

For this reason, they did not want to use any newer forms of technology, but rather wanted to remain using existing forms of technology he was familiar with.

You see all these books here. I prefer to hold a book, and smell the book, and turn the pages and so on... I still like to do that, and prefer it, even to a new device, although I see the advantage of the new device... I'm less interested in the technology ... I enjoy other things better (Male 82 LOC1)

Additionally, an individual suggested that he was reluctant to use technology because of a concern about how much it would cost in relation to their current financial condition.

Cost has to do with it...We are just in a certain salary range, and we pick out what we can and what we can't do so we don't go broke... (Male 80 LOC2)

b. I do not need pedometers!!!

Interestingly, many older residents in this position directly expressed strongly negative emotion to pedometer whether a given pedometer is complex or not. They described both simple and complex pedometers to be worthless independent of their technological advancement.

They (both PES and PEC) don't help me with things I would really like to know like pulse rate, blood pressure, and things like that... They are worthless to me... I don't have any use for those really... To me, they are kind of useless... (Male 80 LOC2)

More specifically, some individuals mentioned that pedometers were simply not compatible with their lifestyle. In this case, older residents may consider the compatibility of pedometer with their current inactive lifestyle or some health issues caused by the aging process.

I'm not physically active now. That is my problem...it doesn't promote your physical activity level, I think... The pedometer isn't useful to us at our age, at our activity level. (Male 80 LOC2)

I'm not walking too much right now because I'm having hip trouble. I'm too older to use them. (Female 84 LOC2) Importantly, our study shows that an older adult can be a 'laggard' with respect to certain forms of

technology, but can be an ‘early adopter’ with respect to other forms of technology. Below are quotations from the same individuals that reflect different types of preferences for different devices.

Well sometimes, right now, every week somebody from University comes and they use Wii Fitness... but I'm sure it costs a lot of money. I mean we play once a week and it's fun, just to get together but you don't want to do that everyday, I don't think. I wouldn't buy... (Female 80 LOCI)

I prefer the pedometer... This is...much more advantageous for me because I want to know the steps I take. (Female 80 LOCI) Both Nintendo Wii and pedometer are types of technology which may promote older adults’ physical activity. However, the older resident expressed negative emotion to Nintendo Wii while expressed positive emotion to pedometer. Although Nintendo Wii and pedometer are very different technology, this finding may indicate that older adults are sometimes situationally specific and they may use newer forms of technology if their circumstances and situations are well fit into a certain types of technology.

Discussion

In the first theme, several factors appeared to play an important role in older adults’ preferences for simple technology. The first factor was lack of help. Previous research has also found easy access to help and technical support to be an extremely important element in older adult technology adoption decisions (Selwyn, Gorard, Furlong, & Madden, 2003). An older adult’s willingness to use new technology has been shown to be influenced by the breadth of the older person’s social network including friends, relatives, and family members. Selwyn (2004) found that since most older adult technology use takes place at their home or residence, the availability of immediate support from family and close relations can be an important predictor of technology adoption. The perception of a lack of support may increase feelings of complexity and anxiety and decrease the likelihood of using technology (Igbaria, Parasuraman, & Baroudi, 1996). This suggests that increased complexity and decreased ease of use play an important role in determining older adults’ technology preferences (Rogers, 2003).

The second reason was Previous Experience. Prior investigations support the idea that previous experiences with technology play an important role in an individual’s decision to use new technology (Hackbarth, Grover, & Yi, 2003). Specifically, Dyck & Smither (1994) stated that older adults often have less previous experience with technology than younger persons and this lack of experience may contribute to higher anxiety levels and a negative attitude toward new technology.

Our study found that some seniors reported incompatibility with lifestyle to be a factor in technology adoption. O’Brien et al. (2008) stated that the compatibility of a technology with one’s existing goals and lifestyle may play a crucial role in older adults’ technology adoption. With regard to innovation and one’s lifestyle, many scholars have emphasized that when a new idea or new technology is compatible with current objectives and values, the new technology may have a greater likelihood of being adopted by the individual (Rogers, 2003; Neil Selwyn, Stephen Gorard, John Furlong, & Louise Madden, 2003)

With regard to older adults’ learning ability and willingness, Catherine and Charness (1995) stated that older adults may experience significantly higher levels of difficulty when they attempt to learn to use new technologies such as computers when compared with younger adults. Their difficulties include taking a longer time to learn and making more errors (Catherine & Charness, 1995). Similarly, Rogers, Meyer, Walker, & Fisk (1998) stated that older generations may perceive more difficulty in learning to use new technologies and that they might need more time than younger generations. Furthermore, some researchers have pointed out that older adults may perceive the learning of new ideas as a serious obstacle because of their perception of age related declines in cognitive and sensory abilities (Cody, Dunn, Hoppin, & Wendt, 1999; Grady & Craik, 2000; Melenhorst, Rogers, & Bouwhuis, 2006; Rogers, Kristen Gilbert, & Cabrera, 1997). Older adult’s physical condition had an influence on their learning ability and willingness to adopt a technology. With regard to the physical condition of older adults and its impact on technology adoption, Chappell (1999) stated that older adults’ poor health and/or impaired physical condition make them feel more concerned about learning, accepting and adopting new technologies.

Although, some scholars support the idea that retirement communities generally contribute to increased social networks and reduced loneliness (Buys, 2000, 2001; McDonald, 1996), residents in retirement communities may experience isolation from former networks including homes, neighborhoods, friends and extended family (Adams, Sanders, & Auth, 2004; Gracia, Moyle, Oxlade, & Radford, 2010). Therefore, older adults who live in retirement communities may have fewer opportunities to be exposed to newer forms of technology. With regard to older residents’ technological isolation, Selwyn et al. (2003) stated that it is extremely important to have access to technology-using friends, family, and neighbors. Additionally, Czaja & Lee (2007) stated that age-related changes in physical and cognitive abilities may limit older adults’ opportunities to access to new technology. Thus, older adults who live in retirement communities may experience decreased trialability and observability of new forms of technology.

The presence of negative experiences may cause older adults to experience frustration and anxiety when contemplating the adoption of new and advanced technology. Technological anxiety often causes people to reduce the amount of time spent using certain forms of technology (Doronina, 1995). These negative feelings may be caused by high levels of complexity coupled with relatively low levels of perceived ease of use

(Venkatesh, 2000). Complexity and perceived lack of ease of use may reduce an individuals' willingness to adopt a new idea or technology (Rogers, 2003). In the second theme, four factors played an important role in older adults' preference to newer or complex forms of technology. Relative advantage refers to the perceived advantage a user feels about a technology (Rogers, 2003), and perceived benefits are defined as one's subjective evaluation of the potential gains related to a new technology (Brown, 2005). Some researchers support the idea that the relative advantage of a technology is one of the most important determinants for adopting a new technology (Czaja et al., 2006; O'Brien et al., 2008). The perceived benefits of a new technology may provide a strong stimulus with regard to whether or not to purchase an item (Kim, Ferrin, & Rao, 2009; Peter & Tarpey Sr, 1975). For older adults, relative advantage or perceived benefits of using new technology may be one of the most important determinants to using or adopting advanced forms of technology. Thus, it is very important to make benefits and/or advantages of technology use visible and tangible for older populations. Additionally, we need to pay close attention to understanding what exactly a relative advantage or a perceived benefit means to older adults (Melenhorst, Rogers, & Caylor, 2001). Many researchers have reported that previous experiences gained through the work place, friends, family, and self-teaching have helped individuals build positive attitudes and allowed for easy access to technology (White & Weatherall, 2000). Shih, Muñoz, & Sánchez (2006) stated that potential users with previous experience tend to spend more time exploring new technology. Many scholars have supported the idea that previous technology experiences are positively associated with future technology adoption (Czaja & Sharit, 1998; Ellis & Allaire, 1999; Melenhorst & Bouwhuis, 2004; Melenhorst et al., 2006). Older adults with previous experiences with technology coupled with socially active personalities are the most likely to adopt new ideas or technologies (Chappell, 1999; Festervand & Wylde, 1988).

Support from family members may help to prevent older adults from feeling that a certain form of technology is too complex and provide them with more opportunities to be exposed to technology. Some researchers believe that support from family, friends, and peers may decrease the complexity and positively influence technology adoption (Chua, 1980; Tan & Teo, 2000). Furthermore, opportunities to be exposed to technology when closely supported by family members may increase older adults' trust in certain technologies. In the last theme, frustration, feelings of fear, and cost played a role in older adults' indifference to technology use. According to Barker (1938), a frustrating situation is one in which obstacles including physical, social, and environmental prevent the satisfaction of one's desire. The frustration can cause older adults to fail and therefore affect their willingness to use new technology (Jutinen & Saariluoma, 2010). Many researchers emphasized that avoiding feelings of frustration in older adults is a very important element for technology adoption (Catherine & Charness, 1995). These feelings of frustration may cause users' to fear using technology (Gatto & Tak, 2008) and may also cause individuals to adopt indifferent attitudes toward technology use (Baumeister & Tice, 1990). For these reason, older individuals are satisfied with their existing technology, but are afraid of new forms of technology. According to Socioemotional Selectivity Theory (Carstensen, 1991), the perception of limited future time may increase an individuals' selectivity with regard to technology adoption. Older adults in particular are more present oriented and less willing to spend their time to accomplish future benefits or goals (Kliegel, Jäger, & Phillips, 2007; Melenhorst et al., 2006). A few individuals suggested that they were reluctant to use technology because of a concerned about how much it would cost in relation to their current financial condition. Their concerns related to cost might have increased their feelings of riskiness and decreased the relative advantages of using technology. Cost of technology has been one important determinant in technology adoption in older adults (Morrell et al., 2000; White & Weatherall, 2000). Older adults' concerns related to cost may have increased their feelings of riskiness and decreased the relative advantages of using technology. Studies have suggested that cost of technology has been one important determinant in technology adoption in older adults (Morrell, Mayhorn, & Bennett, 2000; White & Weatherall, 2000). Melenhorst et al. (2006) suggested that cost reduction may possibly encourage older adults to use and adopt new technology.

Associated with technologies promoting physical activity, it is very important to understand how older adults perceive the technologies rather than the technologies' own characteristics itself. Older adults' perception to technologies can be more complex if the technologies require physical ability such as a pedometer and Nintendo Wii. This is because the interactions between technologies associated with physical activity and older adults may be closely related to older adults' perceived health condition. Older adults' health condition or lifestyle could be one of the most important factors in health related technology adoption. Although, many older participants in this study tended to express negative responses to pedometer which is a technology that tracks physical activity alone, they may be more receptive to tracker technology that assesses multiple dimension of healthy lifestyle including sleep, heart rate, and blood pressure.

Unfortunately, little is known about context-related perceived values of older adults in response to new technologies which may promote older adults' physical activity (Melenhorst et al., 2001). In relation to older individuals' unique personal circumstances, the field of ergonomics emphasizes the need for an understanding of an older individual's everyday 'real' and 'authentic' perspectives toward technology (McDonagh, 2011). The authentic information known as empathic horizon is grounded in the individualized emotions, experiences, situations, and circumstances of potential users. This approach may provide insightful and meaningful information (McDonagh & Thomas, 2010; Shin, Benson, & McDonagh, 2011). This individualized, authentic understanding about the relationship between older individuals and technology may help provide critical

information for older adults' healthy lifestyle choice with technology.

Additionally, the six factors listed in the diffusion of innovation theory provided important motives for adopting new technology. However, the third major theme identified in our study is not easily explained by six factors in the diffusion of innovation; relative advantage, compatibility, complexity, trialability, observability, and riskiness. Older individuals sometimes adopt or avoid certain forms of technology because of their subjective interpretation of their circumstances. Importantly, in certain instances, technology adoption appears to be influenced by a complex combination of socio-cultural factors and not solely by the interaction between an individual and the technology. Interestingly, some individuals reported conflicting opinions about different high technology items. There have been many studies that have addressed the issue of whether older adults are 'laggards' or not. Some studies suggest that older adults are more likely to be later adopters than younger generations (Czaja et al., 2006; Czaja & Lee, 2007; Gilly & Zeithaml, 1985; Hanson, 2010; Jones & Fox, 2009; Morris & Venkatesh, 2000). In our study, many older adults expressed diverse opinions with regard to their feelings about technology and these findings suggest that an older individual might not be a 'laggard' for all forms of technology. They may choose simple or older forms of technology in certain situations, but they may also choose newer or advanced forms of technology in other situations. This theme implies that older adults are sometimes situationally specific with respect to their technology preferences. Melenhorst et al (2006) suggest that different technologies provide different perceived benefits to different older individuals. With regard to older individuals' unique preferences with regard to technology, Chappell (1999) proposed that older adults' technological adoption may be directly influenced by specific individual circumstances.

Conclusions

Recently, numerous and diverse technologies have been developed that have the potential to motivate older adults to adopt more physically activity and healthy lifestyles. In order to utilize these technologies for older adults, it is important to understand the complex interaction process between older adults and diverse technologies. Older adults have long been regarded as a homogeneous group in relation to technology adoption; however, recent studies have asserted that they may be more heterogeneous than was previously thought. Therefore, the acquisition of authentic knowledge about the life experiences of older adults is a key to expand our understanding of what older adults really need and want for their healthy aging. Finally, we hope that insights gained from qualitative studies will contribute to motivate older adults' healthy lifestyle with technology use.

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