

THE EMOTIONAL RESPONSES OF OLDER ADULTS TO NEW TECHNOLOGY

BY

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## Abstract

The world population is aging and the population aged 65 and over is one of the fastest growing age groups. As the number of older adults increases and life expectancy gets longer there is a growing interest in the impact of healthy lifestyles on quality of life in the older population. Among diverse types of healthy lifestyles, physical activity is one of the most popular and effective tools to improve quality of life in older adults. Unfortunately, only a small proportion of older adults participate in regular physical activity. Consequently, many researchers have attempted to motivate members of this population group to become more physically active. There is reason to believe that new technology holds significant promise for improving the health and quality of life of older adults. However, older adults are frequently reluctant to adopt new technologies which have the potential to improve their quality of life.

The present study attempted to understand the perceptions and emotions of older adults when they encounter new forms of technology. Specifically, this study explored the perceptual and emotional reactions of older adults to a number of commercially available technology products. To achieve the above goals, in-depth interviews and Product Personality Profiling techniques were used to assess key elements of innovation theory including relative advantage, compatibility, complexity, trialability, observability, and riskiness. In addition two elements of the Technology Acceptance Model, perceived usefulness and ease of use were also examined.

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? In this study, several diverse elements, including lack of help or support, physical condition with age, lack of opportunity, feelings of frustration and anxiety, feelings of fear, lack of compatibility with lifestyle, lack of benefits, lack of needs, lack of experience or negative previous experience, hard to learn and cost, were shown to impact older adults' decision-making with regard to technology adoption.

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## **CHAPTER 1 INTRODUCTION**

### 1.1 Aging and Older Adults

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 ("2008 Census Data," 2009), older adults aged 65 and over will soon outnumber children under the age of 5. Moreover, the world population age 80 and over will more than double between the years 2008 and 2040.

Aging is generally defined as biological, psychological, or social changes that are dependent upon the passage of time in living organisms. Aging leads to a loss of adaptability, functional impairment, and eventually death (Spirduso, Francis, & MacRae, 2005). In the perspective of geriatrics, aging is defined as a time dependent anatomical and physiological change that influences physiological reserve and functional capacity (Ahmed & Tollefsbol, 2001). Social gerontologists define aging as changes that occur in the organism throughout the life span whether good or bad and that lead to changes in social roles and relationships (Hooyman & Kiyak, 2008). No single definition can adequately explain the aging process.

However, many gerontologists believe that there are at least four different types of aging; chronological, biological, psychological, and social aging. According to Hooyman and Kiyak (2008), chronological aging refers to changes dependent upon the passage of time. For instance, a 75-year-old is chronologically older than a 45-year-old. Biological aging refers to the physical changes that reduce the functionality of an



organism, such as the lung, liver, heart, or circulatory system. Thus, higher efficiency and functional ability of a given organ system may be an indicator of a biologically younger individual. Psychological aging indicates changes in sensory acuity, perception, emotion, mental functions, adaptive capacity, and personality. Social aging refers to age-related changes in social roles and relationships. As people age they need to adjust to varying social structures. Socially active and positive traits could indicate younger social age.

A classic question that has interested gerontologists for many years is “when does old age begin?” (Roebuck, 1979, p. 416). Unfortunately, it is almost impossible to identify either a uniform definition of “old age” or a uniform starting point for old age because the aging process varies from individual to individual, society to society, culture to culture, and age to age. Jugdutt (2010) stated that all definitions of aging are arbitrary and there is no biological starting point for the aging process. However, many groups, organizations, and institutes have attempted to define both old age and the older adult. The World Health Organization (WHO, 2011) identifies the chronological age of 65 years as the starting point of old age in developed countries. In contrast, the United Nations believes that old age begins at 60 years of age.

## 1.2 Older Adults, Healthy Lifestyle, and Quality of Life

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. 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). A healthy lifestyle has been associated with lower risk of CHD (Coronary Heart Disease) mortality in old age (Chiuve, McCullough, Sacks, & Rimm, 2006b) and combination of the above healthy lifestyles has been shown to be effective in lowering the risk of cardiovascular disease, diabetes, and some cancers. Specifically, in the NHS (National Health Service), 70% of total cardiovascular disease, 80% of CHD and 90% of diabetes are associated with poor life style choices including smoking, sedentary lifestyles, poor diet, excessive alcohol consumption, and over-weight. In the Health Professionals Follow-Up Study (HPFS), 79% of CHD in the older population, may have been avoided by adopting low-risk lifestyles (Chiuve et al., 2008a). Healthy lifestyle factors may also be associated with Alzheimer's disease. A healthy lifestyle may lower Alzheimer's disease incidence and have a positive influence on the other chronic conditions (Pope, Shue, & Beck, 2003). Furthermore, a healthy lifestyle has a positive impact on psychological and social aspect of life. Anxiety and depression is closely related to dietary cholesterol, total energy intake, prevalence of smoking, and physical inactivity. Those factors are crucial determinants of a healthy lifestyle (Bonnet et al., 2005) . Bonnet et al. (2005) also stated that physical inactivity is very important factor associated with the level of anxiety or depression.

Quality of life is generally defined as the combination of person's physical condition, self perceptions, observable behaviors, and life circumstances (Hooyman & Kiyak, 2008). In psychology, quality of life is generally defined as a subjective judgment of satisfaction with one's life (Pavot & Diener, 1993). The World Health Organization defines quality of life as an "individual's perception of their position in life in the context

of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.” (WHO, 1997). Quality of life depends on the emotional interpretation and subjectivity of the individual (Xavier, Ferraz, Marc, Escosteguy, & Moriguchi, 2003b). Thus quality of life is closely related to healthy lifestyle choices (Lowry, 2010).

Among many different types of healthy lifestyle, physical activity is one of the most popular and powerful tools to improve quality of life in older adults. Rejeski and Mihalko (2001) emphasized the strong relationship between physical activity and enhanced quality of life in older adults. Buchner (1997) reported physical activity can improve quality of life in the older adult population. Koltyn (2001) reported that higher levels of physical activity may be associated with higher levels of quality of life. Similarly, Acree et al. (2006) stated that older adults who participate in regular physical activity of at least moderate intensity have higher health-related quality of life than those that do not exercise. Similarly sedentary older adults may improve their health-related quality of life by increasing their physical activity levels (Acree et al., 2006). Many previous studies have shown that regular physical activity is beneficial for quality of life in the general population. Furthermore, there have recently been many studies focused on physical activity and patients’ quality of life. For example, Lowe, Watanabe, Baracos, and Courneya (2009) found a significant positive association between physical activity levels and quality of life of cancer patients. Esteban et al. (2010) recently reported that a lower level of physical activity was associated with a significant decline of health related quality of life among patients with chronic obstructive pulmonary disease.

Unfortunately, only a small portion of older adults participate in regular physical activity. About 28% to 34% of adults aged 65 to 74 years and 35% to 44% of adults aged 75 years or older are physically inactive (DHHS, 2002). Thus, it is very important to help the older population to become more physically active. 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, 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.

### 1.3 Older Adults and Technology

In Japan, many video games have targeted older generations and some older adults play such video games regularly (Fukuda, 2011). Traditionally, video games have been marketed to younger users. However, recently new video games are emerging, such as Wii, which have a relatively easy interface and an intuitive design which older adults can easily learn and enjoy. Technology is generally defined as “the application of scientific knowledge (including tools, techniques, products, processes, and methods) to practical tasks” (Czaja et al., 2006a; National Information Center on Health Services Research and Health Care Technology (NICHSR) , 2004).

Recently, many researchers have tried to explain the benefits of technology for older adults. Rosenberg, Kottorp, Winblad, and Nygård (2009) stated that the development of new technology holds significant promise for increasing quality of life in

old age. Park and Jayaraman (2003) have asserted that technology use is one of the most important methods to increase the quality of life for people of all ages. Chumbler, Mann, Wu, Schmid, and Kobb (2004) proposed that use of technology can improve quality of life at home and increase independence for older adults. Furthermore, Pilotto et al. (2011) suggest that both information and communication technology have the potential to help Alzheimer's disease patients to be more independent.

Numerous studies have explored the potential role of technology to help motivate older adults to adopt a healthy lifestyle. Intille (2004) discussed the potential of a ubiquitous computing system that includes mobile computing devices and real-time context-aware computing. For example, by collecting and providing appropriate information, new technologies can assist individuals make lifestyle decisions which may help in the treatment and management of obesity, heart disease, diabetes, stroke, and certain cancers. 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.

As stated above, there is growing interest in the role that interactive video games play in stimulating physical activity among older adults. Most studies to date have focused on examining the physiological benefits of video games. For example, research by Graves et al. (Graves, Ridgers, & Stratton, 2008) suggests that video games can be effective in stimulating increased physical activity levels. Sell, Lillie, and Taylor (2008) stated that participants with greater experience in DDR had greater energy expenditure and greater playing intensity relative to inexperienced participants. Experienced

participants met or exceeded the current recommendations for moderate-intensity physical activity. Hermes, Hitch, Honea, Stephenson, and Bauer (2010) suggested that the Nintendo Wii may be an alternative physical activity option for some older adults.

Unfortunately, only small percentages of older adults have been using new technology to improve their quality of life. For example, Morrell, Mayhorn, and Bennett (2000) found that old-old adults, aged 75-92, are the smallest population group in terms of internet use when compared to other age groups such as middle-aged adults, aged 40-49, and young-old adults, aged 60-74. 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). AARP (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. This is consistent with stereotypes that “many older adults are unable, unwilling, or afraid to use technology” (Mitzner et al., 2010, p. 1719). Two studies (Smith, 2010) (Adler & SeniorNet, 2006) report that older adults are much less willing to use technology in comparison with younger adults.

#### 1.4 Theories of Older Adults’ Technology Adoption

Rogers (2003) proposed that the general population can be classified into five technology use categories; Innovator, Early Adopter, Early Majority, Late Majority, and Laggards. In his theory, late majority and laggards adopt new ideas after the average members of society. Some characteristics of late adopters, which include late majority

and laggards, may have similar characteristics as those found in some older adults. Later adopters may be relatively more conservative, skeptical, cautious, less educated, isolated, risk averse, traditional, and suspicious of innovations. Rose & Fogarty (2010) similarly stated that mature consumers were found more frequently in the Late Adopter and Laggards categories in terms of readiness to interact with new technology. From the consumers' perspective, older adults are often laggards in terms of adoption and tend to negatively interact with new technologies (Botwinick, 1973; Gilly & Zeithaml, 1985b). Because of these negative perceptions to adopting technology, older adults often ignore the possibility of improving their quality of life. Given that the number of potential caregivers for this population will decrease (Hough & Kobylanski, 2009), it is even more important for older adults to get technological help for independent living. For example, there are many technologies that can help older adults to stay active and independent. Smart home technology can provide two-way communication that can be used for monitoring, alarming, and other helpful services for older adults' independent life (Laberg, 2005). Technology has a potential to play an important role in promoting independence among seniors. Unfortunately, only a small proportion of older adults currently use technology to sustain their independent living (Belchior, 2005). 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 useful tools.

Understanding the perceptions and emotions of older adults regarding new technology is important. If the benefits of new technology are perceived to be greater than the difficulties experienced while using new technologies, older adults might be more inclined to adopt potentially useful tools that can help them make healthy lifestyle

choices. McDonagh and colleagues (McDonagh-Philp & Lebbon, 2000; McDonagh, Bruseberg, & Haslam, 2002) suggest that a variety of emotional factors influence the likelihood of a person using a product. Turner, Turner, and Van de Walle (2007) found that older people encounter a variety of challenges when they attempt to learn to use interactive technology. These problems include physical and cognitive factors along with concerns that include attitudinal problems, anxiety, issues about the perceived relevance of the technology to everyday life, usefulness and usability, perceptions of learning abilities in the latter stage of life, the degree of social relationship with the computer and their orientation towards the future or the past.

Most previous studies that have examined older adults' responses to new technology have employed quantitative research designs in which a relatively large number of participants are asked to complete questionnaires or other survey instruments. Using a survey design, Eisma et al. (2004) found that older people regarded complexity and jargon as significant barriers to technology use. Similarly, Ziefle and Bay (2005) studied older adults' feelings toward a simple mobile phone and a more complex mobile phone using a quantitative research design. They found that older adults had a lower willingness to use the complex model than younger individuals; however their performance was equivalent to that of younger users when using mobile phones with low complexity. This suggests that many seniors are more comfortable using simpler designs.

However, in recent years a number of researchers have proposed that qualitative research methods that involve in-depth interviews with a smaller number of participants can also be very valuable in understanding emotional and perceptual reactions to new technology. Rogers and Fisk (2006) examined the willingness of older adults to use new



technologies in the home. They found that advanced technologies for older adults must be designed to meet older adults' needs while considering their capabilities and limitations in order to be acceptable to them. Renaud and Van Biljon (2008) recently studied the needs and limitations of senior mobile phone users. In their study, they proposed a Senior Technology Acceptance & Adoption Model (STAM). This model explained the context of older adult mobile phone use and how various factors affect the adoption process. This conceptual model was designed for predicting older adults' acceptance and adoption of new technology.

### 1.5 Purpose of the study

The present study was designed to explore the perceptual and emotional reactions of older adults to a number of commercially available technology products. Our goal was to increase our understanding of how older adults respond to both frequently used and novel technologies. For frequently used technology, two different types of TV remote controls were used. Specifically, a simple model had only 6 buttons while a complex model had both 40 touch-screen based buttons and 9 additional manual buttons. The size of the buttons on the simple model was substantially bigger than on the complex model. In addition to the TV remotes, we also presented participants with simple and complex versions of commercially available pedometers (step counters). We planned to use pedometers because we believed that relatively few older adults were likely to be familiar with these devices and also because our laboratory was interested in exploring the potential of these devices in motivating individuals to increase their activity levels. The

simple version of the step counter had only one button while the complex model had 4 buttons with each button having a separate function such as reset, memory, set, and mode.

The purpose of this study was to understand how older adults vary in their responses to simple and complex models of technology. By selecting both frequently used devices (TV remotes) and un-common items (step counters), we hoped to examine differences between older persons with regard to their thoughts and feelings when exposed to a variety of different technologies.

## **CHAPTER 2 LITERATURE REVIEW**

The present study employed a qualitative research strategy to explore older adults' reactions, feelings, emotions, and perceptions toward technology with the goal of increasing our understanding of why some older adults are resistant to adopting new technology. The review of the literature was composed of the following sections; (1) aging and older adults, (2) older adults and quality of life, (3) technology and aging, (4) technology and emotion, (5) technology adoption, and (6) research models in technology and aging.

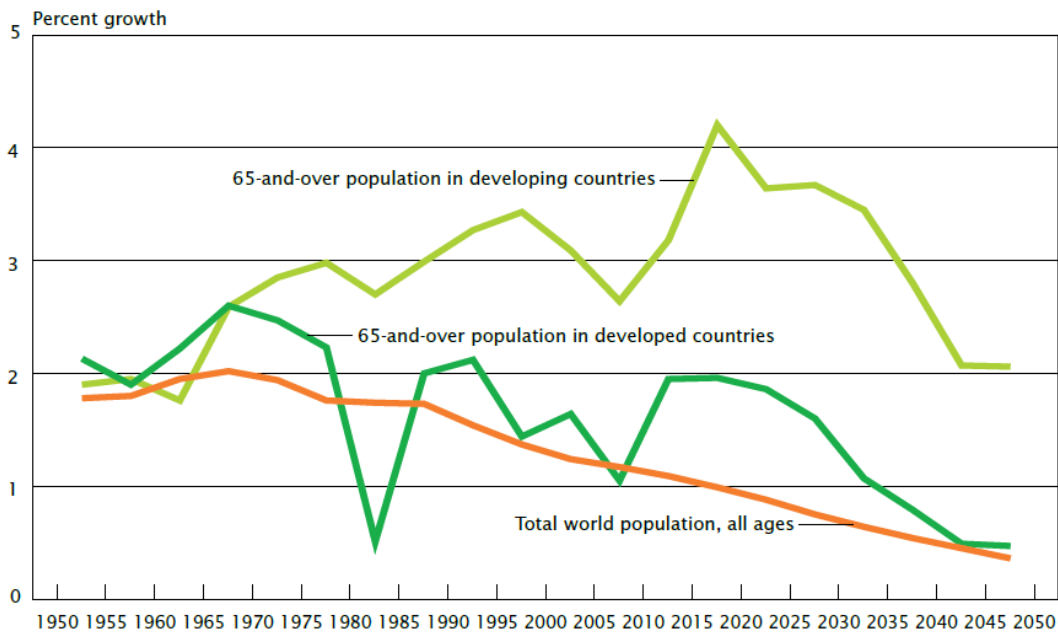
### 2.1 Aging and Older Adults

#### 2.1.1 Demography and aging

The world population is aging and the fertility rate is declining steadily. The U.S Census Bureau (2008) reported that the number of people aged 65 and over in the world was estimated to be 506 million in 2008, and this population group currently accounts for about 7 % of the total world population. The Bureau anticipates that older adults aged 65 and over will number approximately 1.3 billion by 2040, accounting for 14 % of total world population. This global demographic trend is thought to be caused by improvements in public health and hygiene, technological developments, and advances in health care policies (Ahn et al., 2008). A National Institute on Aging report suggests that global aging trends are closely related to the declines in fertility rate and improvements in health and longevity (Dobriansky, Suzman, & Hodes, 2007). Moreover, many developing

countries are experiencing much faster increases in population aging than most developed countries. For example, it took about 100 years for France and Sweden’s population age 65 and over to increase from 7% to 14% of the total population while Singapore and Colombia took only about 20 years (Dobriansky et al., 2007).

Figure 1. Average Annual Percentage Growth of Older Population in Developed and Developing Countries: 1950 to 2050

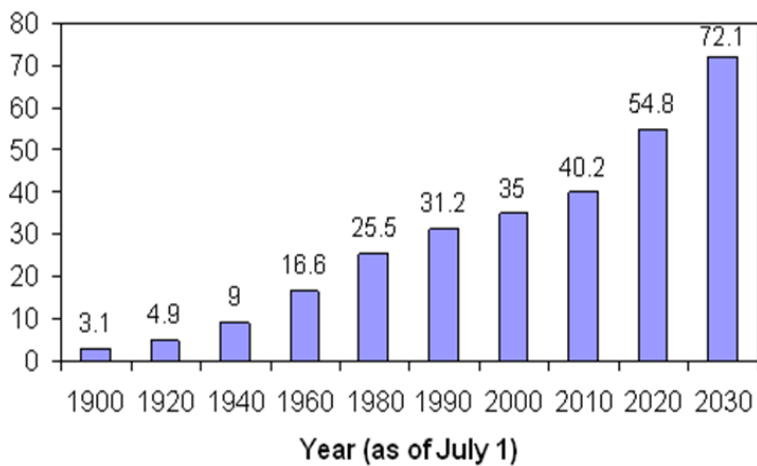


Source: 2008 Census Data

U.S Census Bureau analyses suggest that people aged 65 or over will outnumber children under age 5 in fewer than 10 years. Moreover, the number of people aged 80 and over will increase by more than 200% between 2008 and 2040. While the number of people aged 65 and over will be expected to increase by approximately 160%, the total population of all ages is predicted to increase by less than 35%.

The pattern of aging in the U.S is similar to the pattern of aging in the world as whole. The age group over 65 in the U.S numbered 39.6 million in 2009. This accounts for approximately 13 % of the total population in the U.S. Since 1900, the percentage of the population composed of adults aged over 65 has more than tripled (from 4.1 % in 1900 to 12.9% in 2009), and by 2030 the population will reach an estimated 72.1 million, which is almost twice the number in 2008 (DHHS, 2010).

Figure 2. Number of Person 65+ in U.S. 1900-2030



Source: Department of Health & Human

According to the DHHS, a person who reaches the age of 65 has an average life expectancy of an additional 18.6 years. Older women outnumber older men (22.7 million older women to 16.8 million older men), and approximately half (49%) are aged 75 or more and live alone. Almost 42% of older women in 2009 were widows. In 2009, about 20% of older adults aged over 65 were minorities including 8.3% of African-Americans,

7.0% of Hispanic, 3.4% of Asian or person of Pacific origin, and less than 1 % of American Indians or Native Alaskans. These minority populations are expected to increase from 4.2 million in 2000 to 5.7 million (36%) in 2010, and again to 6.6 million (15%) in 2020. About 30% (11.3 million) of non-institutionalized older adults live alone. In 2008, the major sources of income in the older population were Social Security (87%), income from assets (54%), private pensions (28%), government employee pensions (14%), and private earnings (25%). In 2009, 11% (3.7 million) of older population were still below the poverty level. These statistical data and trends indicate that many older adults experience a both changes and challenges with aging.

#### 2.1.2 Definition of aging and older adults

Although most members of the general public believe that aging is simply the passage of time, many researchers believe that the aging process is much more complex than what commonly thought and is dependent upon a wide variety of phenomena (Arking, 2006). In the 1960's, John Maynard Smith defined aging as the process which makes individuals more susceptible and vulnerable as they get older due to intrinsic or extrinsic factors which can cause death (Smith, 1962). In the 1980's, Strehler asserted that age-related changes must meet the following four conditions; deleterious (i.e., something is considered as a part of the aging process only if it is negative), progressive (the aging process occurs continually and gradually), intrinsic (the aging process excludes the impact of environment, but is derived from inside the body), and universal (all members of a species must experience the aging process as they get older) (Strehler, 1982). Arking defined aging as "those series of cumulative, universal, progressive,

intrinsic, and deleterious functional and structural changes that usually begin to manifest themselves at reproductive maturity and eventually culminate in death” (Arking, 2006, p. 11). Kirkwood and Austad (2000) defined aging as the progressive loss of function, decrease in fertility, and increase in mortality with advancing age. In 2001, Ahmed and Tollefsbol (2001) defined aging as a time dependent anatomical and physiological change that plays an important role in the physiological reserve and functional capacity. Spirduso et al. (2005) similarly stated that the aging process leads to a lessened adaptability, functional impairment, and eventually death. Hooyman and Kiyak (2008) described aging as changes to one’s social roles and relationships as one gets older.

In order to understand the complex aging process more specifically, it is necessary to adopt multidimensional approaches and views. Recently, many gerontologists have begun to take notice of the complexity of the aging process. Hooyman and Kiyak (2008) classified aging into chronological, biological, psychological, and social aging. Chronological aging is defined as an aging process based upon a person’s years from birth. According to this classification, a 75-year-old is chronologically older than a 45-year-old. Biological aging is defined as the physical changes that reduce the functionality of an organism, such as changes to the lung, liver, heart, or circulatory system. This type of aging can be measured by the efficiency and functional ability of an individual. Thus, higher efficacy and functional ability of a given organ system may be an indicator of a biologically younger individual. Psychological aging is defined as the changes in sensory acuity, perception, emotion, mental functions, adaptive capacity, and personality. For example, intellectually and psychologically active individuals are considered to be psychologically younger. Social aging refers to an

individual's altered roles and relationships within in society. Higher social activity and positive traits may indicate younger social age.

Applying a uniform definition to the term “older adult” is not possible because the aging process may differ depending the individual, society, culture, and time period. For example, many developed countries have adopted the age of 65 years as starting point for old age, however, it is doubtful that this criterion can be applied to individuals living in the developing world (WHO, 2011). Jugdutt (2010) concluded that there is no biological starting point for “old age”, and that defining old age is necessarily arbitrary. The World Health Organization similarly stated that there is no general agreement regarding the beginning of old age (WHO, 2011).

Many scholars, groups, organizations, and institutes have attempted to define what old age is and when old age starts. A Joint Rural Health Advisory Committee and State Community Health Services Advisory Committee Work Group (2006) attempted to classify the older population based on chronological age such as “young-old” (age 65 to 74), “old-old” (age 75 to 84), and “oldest-old” (age over 85). Even though there is no universally accepted criterion, the United Nations suggests that the age of 60 years is the cut point to refer to older adults (WHO, 2011).

## 2.2 Older Adults and Quality of Life

### 2.2.1 Definition of quality of life

Quality of life is multidimensional, subjective, and has different meanings to different individuals. The quality of life has been diversely defined, as an individual's



emotional and perceptual responses to his or her life circumstances, the gap between these circumstances and their expectations, and their ability to meet their personal needs and desires (General Considerations, 2003). Since defining the quality of life is fairly complex and difficult, many researchers have focused on finding key domains or elements to clearly address the quality of life (General Considerations, 2003). For example, the constituent elements of quality of life include; psychological, social, and financial well-being, relationships with family and friends, work, leisure, and other aspects of everyday life (Kane, 2002). Quality of life appears to be a concept that is dependent upon an individual's subjective perceptions (Xavier, Ferraz, Marc, Escosteguy, & Moriguchi, 2003a). In 1995, Ware stated that from a biomedical and behavioral perspective, quality of life reflects physical, mental, and social factors related to health status (Ware Jr, 1995).

Cella (1994) proposed that there are four components of quality of life including physical, functional, emotional, and social dimensions. The physical dimension reflects perceptions of body functions. Common examples are pain, nausea, and fatigue. The functional dimension refers to the ability to perform activities related to one's needs, desires, and social roles such as walking, and eating. The emotional dimension pertains to the psychological status of an individual, including both positive and negative affect. The social dimension includes many diverse factors such as perceived social support, maintenance of leisure activity, maintenance of social relationship, family functionality, and intimacy (Cella, 1994). Lawton (1991) suggests that quality of life is multidimensional concept and it has four main domains: objective environment, behavioral competence (including physical and functional health), perceived quality of

life, and psychological well-being, including life satisfaction. According to Sarvimäki & Stenbock-Hult (2000) and Lawton (1991), the environment has an influence on behavioral competence. Behavioral competence then influences the perceived quality of life.

Psychological well-being is the final outcome of this model (Lawton, 1991; Sarvimäki & Stenbock-Hult, 2000). Archer (2007) believes that quality of life is dependent upon six interrelated domains; the metaphysical, the spiritual, the biological, the interpersonal, the environmental, and the societal. The metaphysical domain includes self-esteem, self-determination, cognition, purpose, optimism and life satisfaction. The spiritual domain includes prayer, worship, fellowship and meaning. The biological domain involves functional capacity, physical comfort, health promotion and health maintenance. The interpersonal domain includes social support, interpersonal dynamics and cultural dynamics. The environmental domain includes socioeconomic status, transportation, assistive devices, safety and aesthetics. The societal domain includes one's personal social system and the global societal system (Archer, 2007). Recently, social gerontologists Hooyman and Kiyak defined quality of life as “the combination of person’s functional health, feelings of competence, independence in activities of daily living, and satisfaction with personal social circumstances” (Hooyman & Kiyak, 2008, p. 1). McAuley et al. (2008) similarly stated that quality of life is a multidimensional or umbrella construct including many different aspects such as the physical, social, psychological, and spiritual well-being of an individual.

The term ‘quality of life’ has been studied in a wide variety of disciplines including psychology, medicine, economics, environmental science, and sociology (Costanza et al., 2007). Indeed, the quality of life depends on an individual’s judgment

about how to live well in diverse and broad domains (Costanza et al., 2007; Motl, McAuley, Snook, & Gliottoni, 2009).

### 2.2.2 Aging and quality of life

The aging process results in biological changes throughout the human body (Hooyman & Kiyak, 2008). The aging related changes often increase pathologic conditions of older adults (Goldberger et al., 2002) and subsequently decrease quality of life in older population. For example, body composition such as muscle mass, skin, and hair changes with advancing aging. Organ systems change with aging, including the musculoskeletal and kinesthetic systems, respiratory system, cardiovascular system, urinary system, gastrointestinal system, endocrine system, and nervous system. Aging also has an influence on changes in sensory functions such as sight, hearing, touch, smell, taste (Hooyman & Kiyak, 2008). Due to these fundamental changes with advancing aging, many older adults experience physical and functional declines including vision and hearing impairment, arthritis, osteoporosis, obesity, diabetes, hypertension, heart disease, incontinence, and cancer (Spirduso et al., 2005).

These biological aging changes often lead to a variety of psychosocial consequences. According to Zeiss, Lewinsohn, Rohde, and Seeley (1996) physical health problems with advancing aging are major determinants of depression and have a direct effect on quality of life in older population. Poor health status and physical limitations with aging can lead to loneliness (Hawkley et al., 2008). Many older adults experience social isolation including living alone, with small social networks, infrequent social activities, and feelings of loneliness caused by poor physical and mental health status

(Cornwell & Waite, 2009). Jang, Haley, Small, and Mortimer (2002) found that lower physical and functional conditions are strongly associated with older adults' depression and low socioeconomic status was another factor influencing their depressive symptoms.

Most older adults have been required to adopt a variety of roles throughout their life such as student, mother, grandmother and aging is associated with a change in, or loss of many of these roles (Hooyman & Kiyak, 2008). There is evidence to suggest that social factors can have an influence on cognitive functioning (Charles & Carstensen, 2010). For example, older adults who have strong social networks and high level of social activities are less likely to have declines in cognitive functioning (Charles & Carstensen, 2010).

The cumulative effect of these age-related changes can have a profound impact on the quality of life of older adults (Netuveli, Wiggins, Hildon, Montgomery, & Blane, 2006; Topinková, 2008). Holahan, Holahan, and Belk (1984) observed that older adults are often stressed due to a variety of significant age-related changes, including physical and functional declines, pain and illness, loss of the work role, financial problems, and death of friends, relatives, and spouse. Physical illness and functional declines are negatively related to well-being and quality of life of older adults (Smith, Borchelt, Maier, & Jopp, 2002). Some scholars have emphasized that social and psychological factors of older adults such as self-esteem and a sense of control are major factors influencing an older adults' quality of life (George, 1998; George, Okun, & Landerman, 1985).

Therefore, studying quality of life in older population, which is influenced by a wide variety of aging processes, is important. Many gerontologists have shifted their interests

from studying overall life expectancy to a more focused concentration on healthy life-expectancy and quality of life (Spirduso et al., 2005).

### 2.2.3 Healthy lifestyle, chronic disease, and quality of life

Healthy lifestyle is defined as a lifestyle that has the potential to increase one's quality of life and decrease the likelihood of negative health outcomes (Gold & Miner, 2002). Many scholars consider that lifestyle is one of the most important factors in determining one's health and quality of life (Lyons & Langille, 2000). For example, Wannamethee, Ebrahim, Papacosta, and Shaper (2005) stated that changes in lifestyle such as smoking cessation and physical activity are strongly associated with reduced mobility limitation in older age. Healthy lifestyle can be a cost-effective intervention that can reduce and prevent disability in older. Koertge et al. (2003) found that lifestyle and psychosocial status changes can also reduce morbidity, mortality, and coronary artery disease mortality. Lifestyle has strong relationship with a number of chronic diseases, including hypertension, heart disease, arthritis, diabetes, cancer, stroke, and respiratory diseases (Foley, Ancoli-Israel, Britz, & Walsh, 2004; Meng, Maskarinec, Lee, & Kolonel, 1999). For example, Beilin (1999) observed that controlled lifestyles such as weight control, physical activity, and healthy nutrition have a beneficial effect on cardiovascular risk in hypertension patients. Similarly, Geleijnse, Kok, and Grobbee (2004) reported that a healthy lifestyle, including weight control, physical activity, and low sodium intake and high potassium has a great impact on hypertension in Western societies. Adopting a healthy diet and lifestyle, including adequate body mass index, physical activity and

modest alcohol intake has great potential to prevent hypertension among young women (Forman, Stampfer, & Curhan, 2009).

According to Chiuve, McCullough, Sacks, and Rimm (2006a) eating healthy, regular physical activity, managing weight, and not smoking may reduce coronary heart disease risk. Kromhout, Menotti, Kesteloot, and Sans (2002) similarly reported that lifestyle changes including smoking, alcohol, and physical activity are important determinants of coronary heart disease. Healthy lifestyle choices are strongly associated with all causes of cardiovascular disease and mortality (Mokdad, Marks, Stroup, & Gerberding, 2004).

Arthritis, which is one of the leading causes of physical disability of older adults in U.S (CDC, 2009), also can be improved by adopting healthy lifestyle, including nutrition and weight control, and physical activity. With changes in lifestyle, osteoarthritis patients may experience improved physical function and mobility (Messier et al., 2004). O'Reilly and Doherty (2001) suggested that changes of lifestyle, such as weight reduction and physical activity, to reduce pain and symptoms of osteoarthritis. Combe (2007) similarly emphasized avoiding unhealthy lifestyles, especially smoking and obesity which may increase the risk of rheumatoid arthritis.

Cancer is the second leading cause of death in U.S and most types of cancer may be prevented through healthy lifestyle, including avoid smoking, less high-fat intake, adequate sugar intake, and physical activity (Barnard, 2004). Rock and Demark-Wahnefried (2002) found that weight control, physical activity, and eating healthy are associated with a reduced risk of breast cancer in women. Several studies have also suggested that higher levels of physical activity may be an important determinant to

decrease the risk of breast cancer (Friedenreich, Bryant, & Courneya, 2001; Monninkhof et al., 2007; Rockhill et al., 1999; Verloop, Rookus, Van Der Kooy, & Van Leeuwen, 2000). Norman, Mqoqi, and Sitasc's longitudinal study conducted in South Africa reported that most cancers are strongly associated with one's lifestyle. For instance, lung cancer is related to cigarette smoking and breast cancer is possibly associated with both poor nutrition and smoking (Norman, Mqoqi, & Sitasc, 2006). Marchand, Wilkens, Kolonel, Hankin, and Lyu (1997) suggested that high energy intake, large body mass, and physical inactivity are associated with increased risk of colorectal cancer.

Stroke may also be reduced by lifestyle changes (Galimanis, Mono, Arnold, Nedeltchev, & Mattle, 2009). A healthy lifestyle including no smoking, low body mass index, moderate alcohol consumption, physical activity, and healthy nutrition can reduce risk of most types of stroke in women (Kurth et al., 2006). Chiuve et al. (2008b) considered 5 lifestyle factors such as smoking, physical activity, diet, body mass index, and alcohol consumption and found these factors have an influence on lowering the risk of stroke. The Harvard Alumni Health Study conducted by Lee and Paffenbarger (1998), similarly reported that physical activity has a potential to reduce risk of stroke in men.

A healthy lifestyle has an impact on diverse types of respiratory diseases as well. According to Huovinen, Kaprio, & Koskenvuo (2003) obesity, physical inactivity is a risk factor for asthma in older adults. Twisk, Staal, Brinkman, Kemper, & Van Mechelen (1998) revealed smoking cessation and regular physical activity have a strong relation to lung function. Tsai et al. (2007) conducted a study understanding how television watching, weight, and physical activity play a role in recurring respiratory disease. Garcia-Aymerich, Varrasso, Anto, & Camargo Jr (2009) studied the relationship

between physical activity and chronic obstructive pulmonary disease (COPD) and they proposed that physical activity may reduce the risk of chronic obstructive pulmonary disease.

Among the diverse types of healthy lifestyles, physical activity is known to be one of the most effective ways to prevent chronic disease and to increase quality of life. A great deal of evidence indicates that physical activity allows people to extend their years of active, independent life, reduce disabilities, and improve the quality of life (Spirduso & Cronin, 2001). For older adults, being physically active on a regular basis has been found to be associated with better physical and psychological health (Booth, Owen, Bauman, Clavisi, & Leslie, 2000). Physical activity is closely associated with improvements of older adults' quality of life (Reid et al., 2010) and lack of health may lead low quality of life in older population (Xavier et al., 2003b). Thus, McAuley et al. (2008) emphasized the importance of physical activity to increase older adults' quality of life.

Unfortunately, too few older adults engage in physical activity. According to U.S Department of Health and Human Services (2010), about 32% of older adults aged 65-74 and 18% of older adults aged 75 and over participate in regular physical activity (DHHS, 2010). There is a growing interest in physical inactivity and quality of life in the older adult population (WHO, 2010) . There is growing evidence to suggest that technology may have a role to play in assisting older adults to be more physically active and to raise their quality of life (Consolvo et al., 2006).



## 2.3 Technology and Aging

### 2.3.1 Definition of technology

The word ‘technology’ is derived from the Greek word *technologia* which means the systematic study of art. In the 19<sup>th</sup> century, technology was generally defined as the science of the practical arts and this definition was derived from the work of Johann Beckmann who defined technology as “the science that teaches the processing of natural products or the knowledge of handicrafts” At about the same time the word *technik* in the German language was used to describe the functionality of natural and artificial processes used in manufacture (Fores, 1986; Hansen & Froelich, 1994).

In the modern era, Rogers (2003) defined technology as a design for instrumental behavior that decreases the uncertainty and helps achieve a desired result. A commonly used contemporary definition of technology is “the application of all scientific knowledge, including tools, techniques, products, processes, and methods to practical tasks (Czaja et al., 2006b; National Information Center on Health Services Research and Health Care Technology (NICHSR) , 2004). Others consider that technology is a social process including, social, cultural, and economic values that emerge from a technical problem-solving process (Dyrenfurth & Mihalevich, 1987; Hansen & Froelich, 1994).

### 2.3.2 Technologies, healthy lifestyle, and quality of life

Technology holds great promise for improving the quality of life of older persons (Rosenberg et al., 2009). Numerous researchers have explored the benefit of monitoring technology for older adults’ quality of life. For example, Park and Jayaraman (2003) proposed that technology is one of the most powerful and significant ways to improve

quality of life of both young and older adults. This study introduced the benefits of wearable technology known as smart shirt which uses optical fibers to monitor one's vital signs and other health conditions. Chumbler et al. (2004) tested the feasibility of technology-use in the home. They found that technology could improve both IADL (instrumental activities of daily living) and ADL (activities of daily living) performance in older adults with chronic diseases. Coughlin, D'Ambrosio, Reimer, and Pratt (2007) employed a qualitative method to understand the benefits of smart home technology for older adults. Even though they found some possible barriers, such as usability, reliability, privacy, and affordability issues of technology use, they concluded that technology has the potential to improve older adults' quality of life. Furthermore, Pilotto et al. (2011), suggested that information and communication technology (ICT) could help both Alzheimer's disease patients and their family to lead more independent and healthy lifestyle.

Others have suggested that technology may have a more direct role to play in helping older adults to adopt healthy lifestyles. For example, Culhane, O'Connor, Lyons, and Lyons (2005) found that accelerometers can be used to provide older adults with information about their activity levels and that this information has the potential to reduce the risk of falls. Similarly, Hurling et al. (2007) found that internet and cell phone technology was able to increase and maintain older adults' level of physical activity. Intille suggested that a ubiquitous computing system can be useful for providing lifestyle related information for older adults. This technology may help older adults treat and manage diverse types of chronic diseases such as obesity, heart disease, diabetes, stroke, and certain cancers (Intille, 2004). Miskelly (2005) showed that mobile phone technology

can be used to prevent wandering in patients with dementia. By wearing a mobile phone with GPS, dementia patients could be easily located by their family members or caregivers. de Blok et al. (2006) reported that pedometers enable older adults to be physically active. According to this study, counseling with feedback of a pedometer stimulates patients with chronic obstructive pulmonary disease to enhance their physical activity levels.

Recently, there has been growing interest the relationship between video game participation and physical activity in older adults. In Japan, a variety of interactive video games have been marketed to older adults (Fukuda, 2011). Although video games have traditionally targeted young generations, recently many new video games are emerging that are highly suitable for use by older generations. These games are characterized by simple, easy to use interfaces and attractive age-appropriate content. For example, the Nintendo Wii video game system has been shown to elicit light-to-moderate intensity physical activity and be associated significant physiological benefits (Graves et al., 2008) and health benefits (Graves, Ridgers, Williams, Stratton, & Atkinson, 2011). Similarly, Young, Ferguson, and Craig (2011) found the Nintendo Wii balance board to provide safe, feasible, and cost effective balance training for older generation. The Dance Dance Revolution, low-cost video game system, has also been shown to be beneficial for older adults for improving balance (Smith, Sherrington, Studenski, Schoene, & Lord, 2011).

Interactive video games, such as Nintendo Wii, Sony PlayStation, and Microsoft Xbox, have potential for older adults to increase motor control including balance and walking pattern by stimulating sensory cues (de Bruin, Schoene, Pichierri, & Smith, 2010). Playing video games such as Donkey Kong and Pac Man has been shown to

significantly improve older adults' reaction time (Clark, Lanphear, & Riddick, 1987), and these are deemed to be an effective ways to improve perceptual and cognitive ability (Boot, Kramer, Simons, Fabiani, & Gratton, 2008).

In summary, a wide variety of different video games have been shown to have potential for assisting older adults compensate for numerous age-related (Selwyn, Gorard, Furlong, & Madden, 2003b) and have the potential to enhance independence and quality of life for both older adults and their families (Czaja & Lee, 2007; Gatto & Tak, 2008).

### 2.3.3 Older adults and technology use

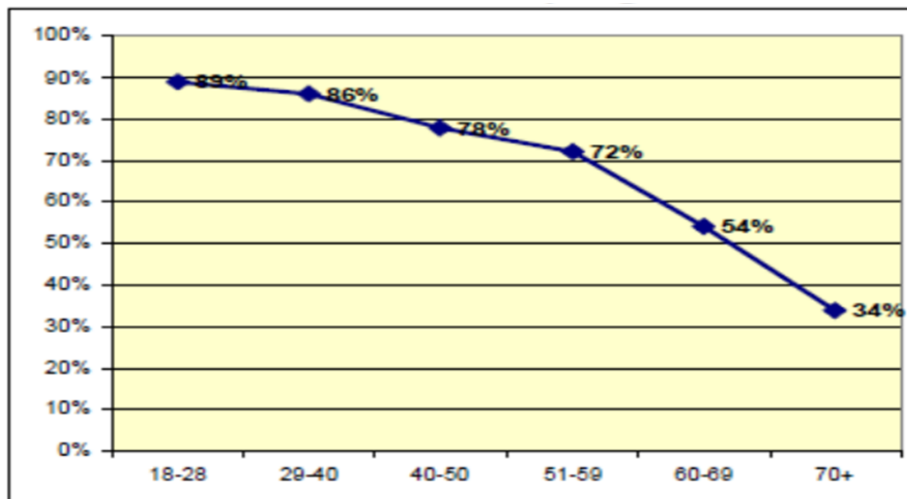
Although older adults are exposed a wide variety of technologies in their everyday lives (Blackler, Mahar, & Popovic, 2009) , numerous studies suggest that older adults are less likely to adopt new technology than younger individuals. For example, only a small portion of older adults use computer as a means of communication (approximately 25%) and less than 5% of internet users are aged 65 and over (Miller, 1996). Morrell et al. (2000) found that only about 5% of older adults aged 65 and over use computers compared to 45% of young adults. Moreover, old-old adults, aged 75-92, are the least likely to use the internet in comparison with other age groups. In 2001, only about 17% of people aged 50 and over used the internet (Czaja & Lee, 2001).

Internet usage decreases with advancing age. For instance, only 14% of male and only 8% of female aged 65 and over use internet while 41% of males and 34% of females aged between 55 and 64 use the internet (Adams, Stubbs, & Woods, 2005). According to a recent survey conducted by AARP (2009), only about 22% of people aged 50 to 64 do not use a computer while more than 50% of people aged 65 and over do not use a

computer (Keenan, 2009). Although many surveys show that the numbers of older adult computer and internet users are steadily growing, the overall number of older users is still much lower than younger users. For example, U.S Census Bureau's 2012 survey reported that about 42% of people aged 65 and over used a computer in 2010 compared with about 78% of people aged 50 to 64.

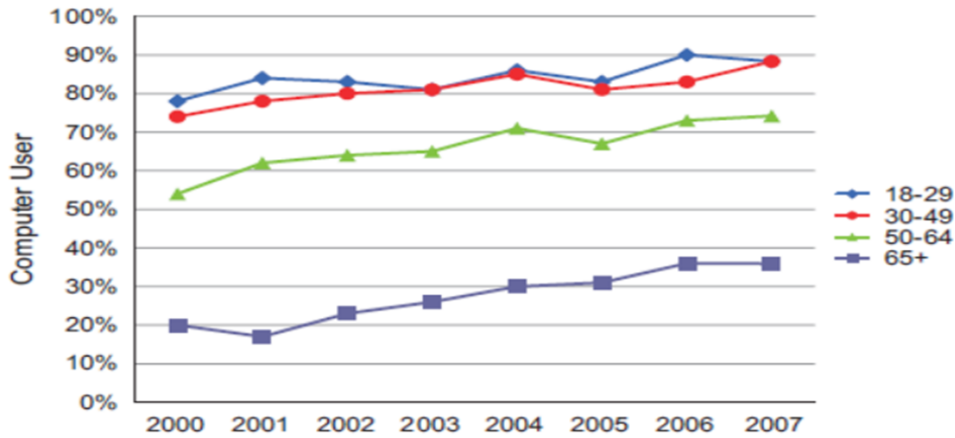
Mitzner et al. (2010) has suggested that adults aged 65 and over are less likely to use internet or a computer because they are unable, unwilling, or afraid to use technology. Older adults are generally less likely to adopt new technology compared with younger persons (Adler & SeniorNet, 2006; Smith, 2010). Interestingly, the AARP reported that only 2% of people aged 50 and over own an iPad (Koppen, 2010). Older adults commonly report feeling less comfortable, confident and in control when using computers (Czaja & Sharit, 1998).

Figure 3. U.S Internet Use by Age 2006



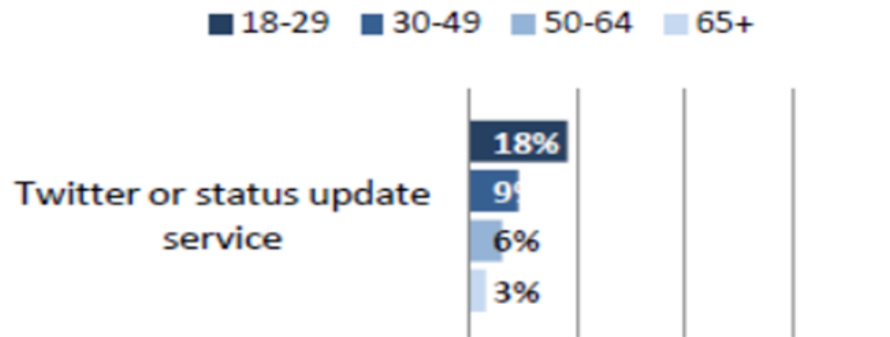
Source: Smith (2010). Home broadband 2010

Figure 4. U.S Computer Use by 2000-2007



Source: Pew Tracking Survey for Years, 2000-2007

Figure 5. U.S Twitter User's by Age



Source: Pew Tracking Survey for Years, 2000-2007

## 2.4 Emotional and Perceptual Factors in Technology Use

Although there is no singular definition of emotion (Cabanac, 2002), it has widely been defined as a conscious mental reaction, including fear, surprise, anger, and joy,

caused by subjective experiences (Merriam-Webster, 2011). Emotions have a strong effect on perceptions (Clark & Williamson, 1989; Forgas, 1991; Isen, 1984; Niedenthal & Setterlund, 1994). For example, when people feel happy, they may be more likely to perceive everything more positively (Niedenthal & Setterlund, 1994).

Perception has been defined as a psychological function which enables the organism to receive and process information from the outside environment (Bunting, 1988; Cumming, 1972). Traditionally perception and emotion were thought to be different domains of study. However, many researchers now propose that perception and emotion are not entirely separable from each other because perceptions are affected by emotion. Emotions can influence the perception of attributes such as perceived costs and benefits (Zadra & Clore, 2011) and perception can influence decision making (Loewenstein & Lerner, 2003). For example, older adults are less likely to use technologies that are perceived to be less beneficial and more difficult to use.

McDonagh and her colleagues (McDonagh-Philp, 2000; McDonagh et al., 2002) have found that a wide range of emotional factors have an influence on technology use and/or adoption. McDonagh-Philp (2000) emphasizes the importance of functionality in product design. Understanding user perceptions and emotions is central to her concept of “soft functionality”. This concept includes emotional needs and other intangible, qualitative aspects that affect the relationships of the users with products (McDonagh et al., 2002). Porter and Donthu (2006) explored determinants of internet use in older population. Their findings indicated that perceived ease of use, perceived usefulness, and perceived access barriers can be significant emotional and perceptual factors influencing on older adults’ internet use. Conci, Pianesi, and Zancanaro (2009) similarly emphasized

not only feeling safe but also enjoyment and fun as experiential factors in mobile phone adoption among older adults. Turner et al. (2007) examined older adults' challenges and problems when they encounter new technology. Older adults' challenges and problems using technology include not only physical and cognitive factors, but also diverse perceptual and emotional issues such as, anxiety, usability, social relationships, learning, and values of technology to everyday life. Charness & Boot (2009) attempted to understand some of the reasons why older adults are reluctant to use new technology. They suggest that a wide range of concerns make older adults less inclined to use technology, including attitudinal (e.g. computer anxiety) and cognitive barriers (e.g. complexity of technology), age-related changes (e.g. vision and motor control), and privacy issues. Because of these perceived concerns, older adults might be less inclined to use and adopt new technology (Charness & Boot, 2009). For example, although new technologies have great potential to increase agricultural productivity, not all older farmers adopt computers on their farm. The reason is that the perceived complexity of the technological systems is much higher than what older farmers are comfortable with leading to lower utilization rates (Sassenrath et al., 2008).

## 2.5 Theories of Technology Adoption

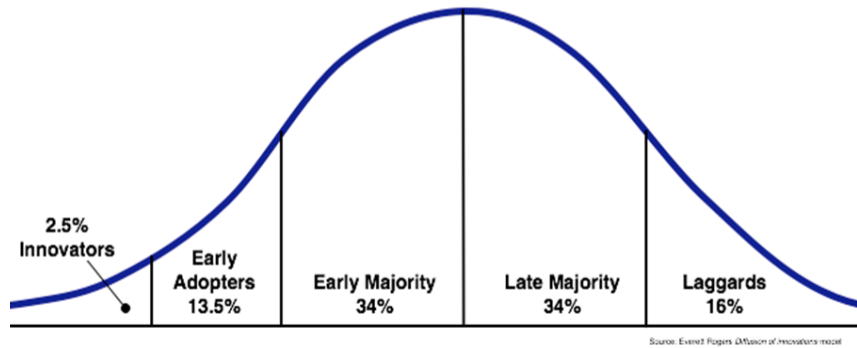
### 2.5.1 Diffusion of Innovation

The diffusion of innovations theory explains when and how a new idea, practice, or object is accepted or rejected by individuals or societies (Rogers, 1995; Rogers, 2003; Vishwanath & Goldhaber, 2003). Rogers (2003) suggest that the population can be divided into five different groups; Innovators, Early Adopters, Early Majority, Late



Majority, and Laggards. An innovator is a person who is likely to accept new ideas relatively earlier than the average member of a society and who has an ability to understand and apply complex technical knowledge well before most members of society. Innovators often participate in the development, beta-testing, and implementation of new technology. The early adopters are among the first to begin use the new technology that have been developed by the innovators. The early majority is characterized by their willingness to begin to use new technology once they have been thoroughly tested and shown to be reliable and of value. The late majority tends to be more skeptical of new ideas and only switch to new technologies when their use has been widely established and accepted. Finally, laggards are isolated, cautious, and suspicious of innovations and actively resistant to change (Rogers, 2003). Rogers (2003) studies Cell Phone Laggards in Hong Kong. These individuals had still not adopted cell phones by 2000 when 77 % of the total population in Hong Kong was using cell phones. Among the reasons stated by the laggards for not using cell phones were complexity (hard to use), incompatibility (expensive), and disadvantage (no need)

Figure 6. Adopter Categorization on the Basis of Innovativeness



Source: Diffusion of Innovations, 2003

Some researchers have suggested that there may be an overlap between the characteristics of late majority adopters and laggards and many older adults. Late adopters and older adults tend to be more conservative, skeptical, cautious, isolated, risk averse, traditional, and suspicious when they encounter new innovations. Rose and Fogarty (2010) suggest that older consumers are late adopters because they are less inclined to readily interact with new technology (Rose & Fogarty, 2010). Botwinick (1973) and Gilly and Zeithaml (1985b) similarly found that older adults are likely to be laggards and tend to negatively interact with new technology.

Rogers suggested five characteristics of innovation that explain why individuals show different rates of adoption (Rogers, 2003; Vishwanath & Goldhaber, 2003). In Rogers' theory, five characteristics include relative advantage, compatibility, complexity, trialability, observability. Relative advantage refers to the degree to which an innovation is perceived as better than the idea it supersedes (Rogers, 2003). The greater perceived relative advantage the quicker the adoption. Compatibility refers to the degree to which

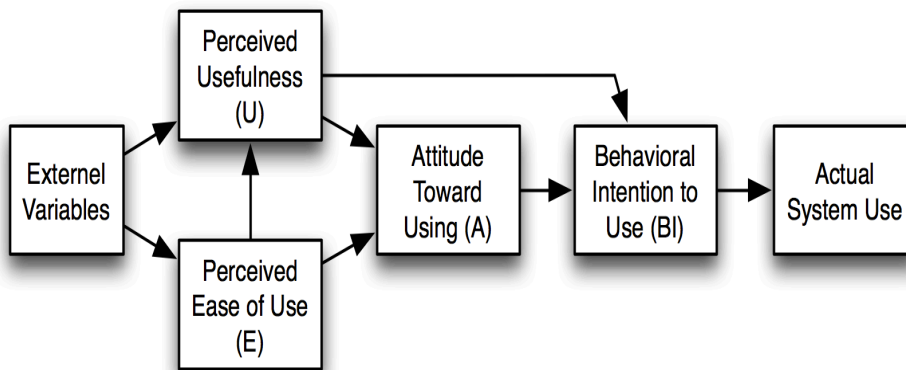
an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopter (Rogers, 2003). An idea, practice, or object that is incompatible with the values and norms of an individual will not be adopted as fast as an innovation that is compatible. Complexity is the degree to which an innovation is perceived as difficult to understand and use (Rogers, 2003). The adoption of a simpler idea, practice, or object is generally faster than that of a more complicated one. For example, Sassenrath et al. (2008) found that more complicated technologies in agriculture, such as new crop models, exhibited slower rates of acceptance by farmers. Trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 2003). More chances to experience a product tend to accelerate the rate of adoption of new innovations. Observability indicates the degree to which the results of an innovation are visible to others (Rogers, 2003). Frequent exposure to new products tends to increase the rates of adoption. This study added the riskiness factors into the Rogers' theory. Riskiness means the perceived risk when people adopt new ideas (Ram, 1987).

### 2.5.2 Technology Acceptance Models

The Technology Acceptance Model (TAM), developed by Davis (1985), is an empirical model which explains how potential users come to accept or reject a technological innovation (Conci et al., 2009; King & He, 2006). The TAM models based on the theory of reasoned action by Ajzen and Fishbein which proposes that an individual's subjective beliefs have a great influence on subsequent attitudes, intentions and behaviors (Ajzen & Fishbein, 1980; Lederer, Maupin, Sena, & Zhuang, 2000). In this model, actual system use (technology acceptance) is determined by behavioral intention

to use and behavioral intention to use is influenced by attitude which is also jointly affected by an individual's belief system that includes judgments about perceived usefulness and perceived ease of use (Lu, Yu, Liu, & Yao, 2003).

Figure 7. Technology Acceptance Model (TAM)



Source: A technology acceptance model for empirically testing new end-user information systems, 1985

The TAM has been widely used for exploring both the influence of both external and internal factors which influence an individuals' beliefs (perceived usefulness and perceived ease of use), attitudes, and intentions (Conci et al., 2009). King and He (2006) has suggested that the TAM is valid and robust model to explain and predict potential user's behavioral intention toward technology adoption.

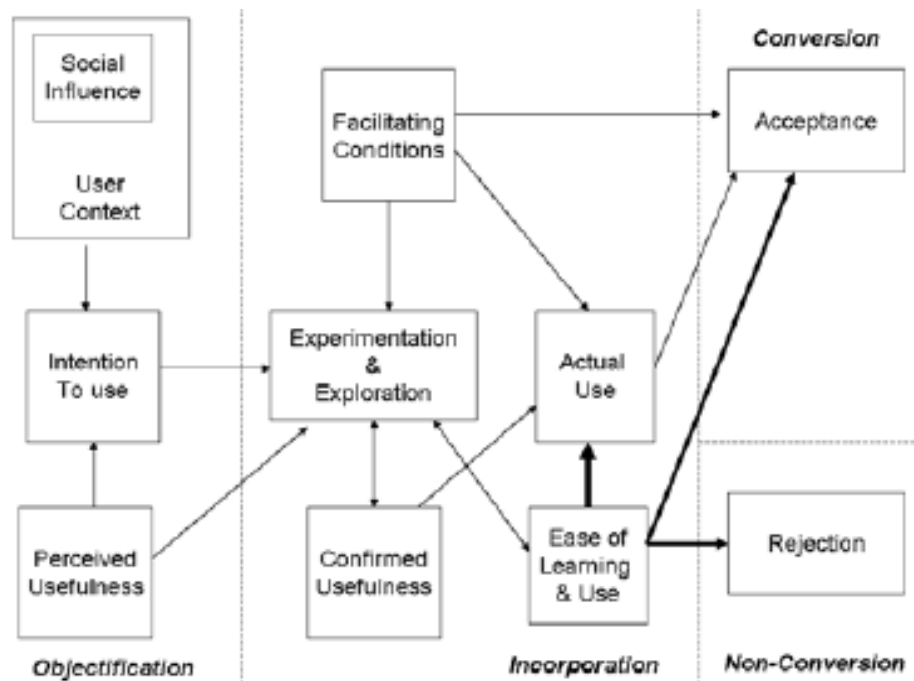
Among the many factors influencing on how people accept or reject technology, the TAM model emphasizes two determinants which are perceived usefulness and perceived ease of use (Venkatesh, Speier, & Morris, 2002). People tend to place emphasis on subjective beliefs about whether a given technology will improve their lives.

In addition, Venkatesh (2000) has suggested that ease of use perceptions involve a subjective assessment of the amount of effort needed to learn to use a new device or program. For example, although potential users may believe that a given technology is potentially useful, they might decline to adopt the technology if they feel it is too hard to use or too hard to learn (Davis, 1989).

Since TAM was proposed, many studies have used the model to examine a wide range of issues with regard to technology use and adoption (Liu, Chen, Sun, Wible, & Kuo, 2010). There have been many efforts to supplement and amend the TAM model to more precisely and adequately explain a wide range of cases with regard to technology acceptance. For example, Chircu, Davis, and Kauffman integrated 'trust' into the original model. They believed that trust is a strong determinant of perceived usefulness and ease of use (Chircu, Davis, & Kauffman, 2000; Pavlou, 2003). Igbaria (1993) extended the TAM model for microcomputer technology acceptance. This study emphasized perceived usefulness, computer anxiety, and computer experience as strong determinants of intention to use microcomputer technology (Igbaria, 1993). Based on Igbaria's study, Kwon and Chidambaram modified the TAM model. Their model includes individual characteristics, perceived ease of use, intrinsic motivation (enjoyment), extrinsic motivation (perceived usefulness), and social pressure (Conci et al., 2009; Kwon & Chidambaram, 2000). Biljon and Kotzé (2007) proposed a Mobile Phone Technology Adoption Model (MOPTAM). They found that mediating factors including personal, demographic, and socio economic factors have an influence on determining factors like social influence, perceived usefulness and perceived ease of use, facilitating conditions, and behavioral intention. This model emphasized social influence and facilitating

conditions (Conci et al., 2009; Renaud & van Biljon, 2008). Recently, Renaud and van Biljon (2008) proposed the senior technology acceptance & adoption model (STAM) which explains the context of older mobile phone user's adoption.

Figure 8. Senior Technology Acceptance & Adoption Model (STAM)



Source: Predicting Technology Acceptance and Adoption by the Elderly, 2008

The STAM model consists of three phases including objectification, incorporation, and now-conversion. The objectification phase is influenced by social factors and perceived usefulness. The incorporation phase means experimentation and exploration. In this phase, potential users try to experience a given technology. Facilitating conditions,

confirmed usefulness, ease of use influence on actual use. Finally, in non-conversion phase, potential users make a decision whether they accept or reject a given technology (Renaud & van Biljon, 2008). STAM model is meaningful because the model targets only older users who may have unique needs, capabilities, preferences, experiences, and limitation from young adults (Mynatt & Rogers, 2001).

In summary, this chapter specifically looked into aging process and its relationship with quality of life in older population. The aging process may cause physical, functional, psychological, and social changes in older population. These cumulative changes have a great influence on older adults' quality of life. One of ways to improve older adults' quality of life is through technology use. Technology holds a great promise for improving the quality of life in older population. Unfortunately, older adults are less likely to adopt new technology due to their emotions and perceptions. Therefore, understanding the perceptions and emotions of older adults regarding older adult's technological reluctance is extremely important. The present study employed two main theories, which are diffusion of innovation and technology acceptance model, to explore older adults' emotions and perceptions toward new technology.

## CHAPTER 3 METHODOLOGY

*Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system...An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 1995, p 5)*

### 3.1 Introduction

The purpose of this study was to understand the perceptual and emotional responses of older adults towards technological products. More specifically, the study had three objectives. First, this study focused on understanding older adults' emotions and perceptions when they encounter new technology. Second, this study aimed to understand factors influencing their technological decision-making. Finally, this study attempted to shed light on two existing theories related to the diffusion of innovation and technology acceptance model. To achieve the above goals, in-depth interviews were conducted to assess key elements of innovation theory including relative advantage, compatibility, complexity, trialability, observability, and riskiness (Rogers, 2003) and two main concepts of the technology acceptance model including perceived usefulness and ease of use (Davis, 1985).

Understanding older adults' emotions is a complex and malleable process (Carstensen & Mikels, 2005) and explaining interactions between older adults and technology is even more complicated. Fortunately, qualitative methods can provide researchers with a window through which to explore complex and delicate situations



(Maxwell, 2005) . Maxwell suggests that there are five intellectual goals of qualitative research (Maxwell, 2005) :

1. Understanding the meaning, for participants in the study, of the events, situations, experiences, and actions they are involved with or engage in.
2. Understanding the particular context within which the participants act, and the influence that this context has on their actions.
3. Identifying unanticipated phenomena and influences, and generating new, “grounded theories” about the latter.
4. Understanding the process by which events and actions take place.
5. Developing causal explanations.

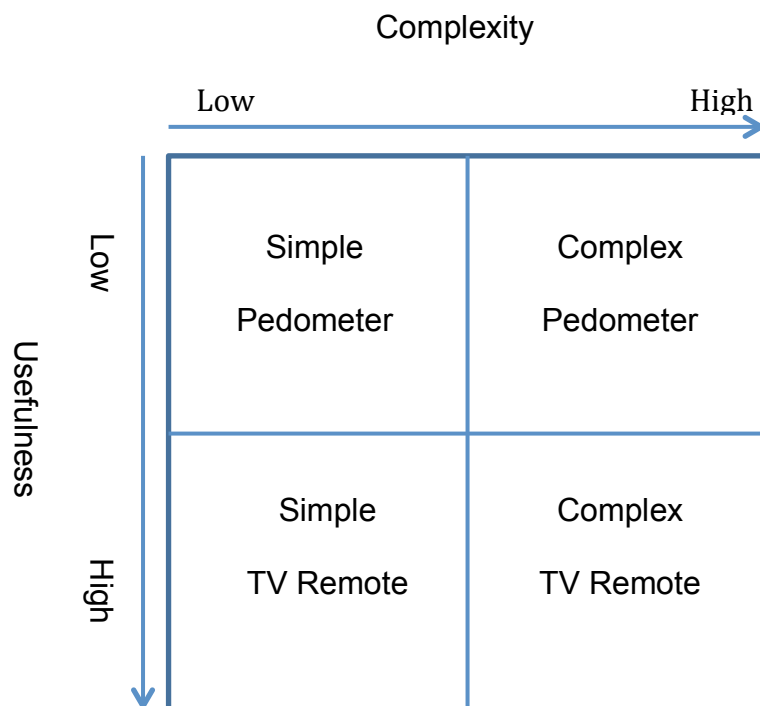
This chapter discusses the overall research methodology used for the study. It consists of a description of study design, data collection, data analysis, and authenticity and trustworthiness.

### 3.2 Study Design

In this study, in-depth interviews were employed to explore the older adults’ emotional and perceptual responses toward new technology. In addition, this study also used the Product Personality Profiling (PPP) technique (McDonagh et al., 2002) to study the nature of interactions between older adults and technological devices. Participants were asked to examine four different technological devices. Two TV remote controls (simple vs. complex) and two pedometers (simple vs. complex) were presented to participants. The reason we chose TV remotes and pedometers as research tools was that

they have different natures in terms of perceived usefulness. Generally, a pedometer is thought to be a less essential item for everyday life than a TV remote. In addition, the reason for selecting simple and complex models of each type of device is to explore how the complexity of a device affects older adults' emotional and perceptual responses.

Figure 9. Product Evaluation Matrix



### 3.2.1 Product Personality Profiling

*Participants are asked to imagine a product as a person with a particular personality, and provide information regarding its character and lifestyle...this technique helps to understand user's emotional responses to products (McDonagh et al., 2002, p 233).*

This technique involved asking participants about their perception and beliefs regarding a particular product. Individuals were asked to link a particular product with a series of personality characteristics and other attributes of a potential user. Participants were requested to carry out a given task in a short period of time (5-10/min/product) in order to provide immediate gut responses (McDonagh et al., 2002). The technique provided insights into who users imagine to be target consumers. Participants were asked to imagine a product as a person with a particular personality, and provided information regarding the product's character and lifestyle. In this session participants were invited to examine four devices, two TV remote controls and two pedometers. Two different types of television remote controls (simple vs. complex) and two different types of pedometers (simple vs. complex) were presented to the participant, one at a time. Each participant was asked to examine each item for a short period of time (5 min/product) and then was asked to fill out the Product Personality Profiling form for that item. Participants were asked to complete the PPP in less than 10 minutes in order to secure prompt and immediate feedback. One of the differences between the original PPP method (McDonagh et al., 2002) and the method for the current study was that we used actual products, instead of showing participants photographic images of products. One advantage of using real products was that participants were able to actually touch and attempt to use the products. In addition, we also gave participants additional time (5 min/product) beyond what was allowed in the previous method (2-3min/product), because the cognitive processing speed of older adults may be somewhat less rapid than is the case for younger adults. In order to avoid possible order effects, the PPP sequence was counter balanced.

### 3.2.2 In-depth interview

*Interviewing is a type of conversational face-to-face interaction (Wengraf, 2001) and its purpose is to enable researchers to enter into the other person's perspective (Patton, 2002).*

Following the completion of the PPP questionnaire, a standardized open-ended interview and the informal conversational interview were conducted. The interview guide included a set of pre-planned questions. The standardized open-ended interview approach had four main advantages. First, the approach enabled the reader to inspect the findings of the study easily. Second, standardized questions enabled the researcher to minimize variations across interviewees by asking same questions. Third, this approach allowed using interviewing time efficiently by asking prepared questions. Fourth, this approach enabled easy finding and comparison for analysis (Patton, 2002) .

However, because of its inflexible nature this approach may not be adequate for dealing with unexpected topics or issues. Therefore, this study combined the semi-structured interview technique and the informal conversational interview. The informal conversational interview approach provided maximum flexibility to gain information by interviewing. This approach focused on the natural interaction between interviewer and interviewee and permits the asking of spontaneous questions that take advantage of the direction that the conversation takes. The advantages of this technique were flexibility, spontaneity, and responsiveness to individual and situational diversity (Patton, 2002) . Each interview lasted for approximately 60-90 min for each participant. All of the interviews were audiotaped and transcribed verbatim.

## Interview Questions

In order to avoid the effect of interviewer's bias on participants' answer, interviewer will use abbreviations indicating four devices.

*(Item A – Simple TV remote, Item B – Complex TV remote, Item C – Simple Pedometer, and Item D – Complex Pedometer)*

### TV REMOTE CONTROLS

1. Describe how you feel about the item A. Why?
2. Who is likely to use the item A? Why?
3. Describe how you feel about the item B. Why?
4. Who is likely to use the item B? Why?
5. What is different between item A and B?
6. Which type of TV remote controls do you want to use? Why?  
(Which type of TV remote controls do you not want to use? Why?)
7. Do you think that TV remotes that you chose can improve quality of your life?  
Why and how? What about the TV remote that you did not choose?

### PEDOMETERS

8. Describe how you feel about the item C.
9. Who is likely to use the item C? Why?
10. Describe how you feel about the item D.
11. Who is likely to use the item D? Why?

12. What is different between item C and D?
13. Which type of pedometers do you want to use? Why?  
(Which type of pedometers do you not want to use? Why?)
14. Do you think the pedometer that you chose can promote your physical activity?  
And how? What about the pedometer that you did not choose?

#### NEW TECHNOLOGIES

15. How comfortable are you with new technologies in general? Why?
16. Describe your first experience with technology use in your early life.
17. How important were new technologies in your early life?
18. Describe your recent experience with technology use.
19. How important are new technologies in your life now?
20. Is there any difference of your preference toward new technologies between when you were young and now? Why?
21. How do you think of the importance of new technologies in the quality of life of older adults? Why?

#### NEW TECHNOLOGIES PROMOTING PHYSICAL ACTIVITIES & QUALITY OF LIFE

22. Describe your experience with new technologies for your physical activity.
23. How do you use new technologies for your physical activity now?
24. Did technologies promote your physical activity level in your early life? How?  
What kind of?

25. Do technologies promote your physical activity level in your current life? How?  
What kind of?

26. How important are new technologies for promoting physical activity in the lives  
of older adults?

### 3.3 Data collection - demographic and descriptive data

The following section introduces information with regard to sample size, the research participants and setting.

#### 3.3.1 Sample size

*In purposeful sampling the size of the sample is determined by informational considerations. If the purpose is to maximize information, the sampling is terminated when no new information is forthcoming from new sampled units; thus redundancy is the primary criterion (Lincoln & Guba, 1985; Patton, 2002).*

This study included a total of 20 participants; 10 participants from Clark-Lindsey Village and 10 participants from Champaign County Nursing Home. One of the goals of qualitative research is to obtain insight into a particular phenomenon, and qualitative researchers often view the establishment of sample size differently from quantitative researchers (Connolly, 1998; Onwuegbuzie & Leech, 2007). Importantly, qualitative studies emphasize ‘theoretical saturation’ which suggest that research should stop sampling when no additional data are being found (Glaser & Strauss, 1967). Since qualitative research can often reach the theoretical saturation level with a relatively small

sample size, qualitative research commonly selects a relatively smaller sample than quantitative research. This way of sampling is known as ‘purposeful sampling’ (Patton, 2002) . This is a strategy to deliberately select research participants in specific settings, individuals, or phenomenon for collecting dense or rich information (Maxwell, 2005).

Given the importance of sampling within qualitative research, many researchers have attempted to suggest an adequate sample size for the theoretical saturation level in a qualitative study. For example, Creswell (Creswell, 1998) suggested that interviews for phenomenology research should include more than 10 people and more than 20-30 interviews for grounded theory research. Morse (1994) mentioned that qualitative researchers use at least 6 participants in investigations to fully understand participants’ essence of experience.

### 3.3.2 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. 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.



### 3.3.3 Setting

The investigator selected Clark-Lindsey Village and Champaign County Nursing Home as research locations. Clark-Lindsey Village is relatively more enriched than Champaign County Nursing Home (Malavasi, 2010) . This study expected to see diverse perspectives of older residents derived from the different nature of the two locations.

#### A. Clark-Lindsey Village

The first location selected for study was Clark-Lindsey Village. Clark-Lindsey Village is a continuing care retirement community located in Urbana, Illinois. This facility consists of four different sub-communities including independent living, assisted living, a therapy center, and nursing home. This facility has 132 apartments in nine different floor plans that ranged from 490 square feet to 1400 square feet. Further, it has 19 assisted living, 58 nursing and 25 Medicare-certified beds. Currently this facility has more than 250 residents, age 50-85 older. About 200 employees are providing diverse services for residents such as dining, nursing, housekeeping and physical activity programs (Clark-Lindsey Village, 2012).

#### B. Champaign County Nursing Home

The second location selected for this study was the Champaign County Nursing Home. This is a public facility that offers long-term, rehabilitative, adult daycare, and memory care services for relatively low-income older adults (Champaign County Nursing Home, 2012) . The Champaign County Nursing Home is located in the middle of a public complex which has several county departments including the Champaign County

Humane Society, and the Champaign County Regional Planning Commission (Malavasi, 2010) . This facility has about 200 residents, age 50-103 and the median age is about 87. Most residents have multiple, chronic medical conditions, including cardiac and pulmonary problems, kidney failures, Parkinson's, and dementia (Champaign County Nursing Home, 2012) .

### 3.4 Data analysis

The purpose of this section was to describe how the data collected were analyzed in the study. Both inductive and deductive analyses were used for interpreting and analyzing the interview data. Inductive analysis includes discovering patterns, themes, and categories from a given data. Deductive analysis analyzes the data according to an existing framework (Patton, 2002).

The inductive analysis was performed with the constant comparative method which makes comparisons at each level of the analytic process (Charmaz, 2006; Glaser B, 1967). Constant comparative analysis enables researchers to identify patterns, code data, and categorize the findings (Anfara, Brown, & Mangione, 2002). Typically, qualitative data analysis is inductive in the beginning stages, especially, when developing codes for content analysis or finding initial categories, patterns, and themes. This is called open coding (Patton, 2002; Strauss & Corbin, 1998). Therefore, 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 had been established through inductive analysis, then confirmatory stage of analysis was performed. The deductive analysis test affirmed the authenticity and appropriateness of the inductive context analysis, including carefully examining deviant cases or data which cannot be categorized (Patton, 2002). Further, both qualitative comparative and analytic induction approaches were performed to look for undiscovered phenomena within the setting. Qualitative comparative analysis focuses on making comparisons to generate explanations (Patton, 2002). Typically, the qualitative comparative analysis method is based on the perspective that the same outcome may be found in different combinations of conditions or settings (Dixon-Woods, Agarwal, Jones, Young, & Sutton, 2005). In this study, the analysis technique was used to make case comparison between Clark-Lindsey Village and Champaign County Nursing Home, thereby elucidating both similarities and differences (Patton, 2002; Ragin, 2000).

In combination with qualitative comparative analysis, analytic induction techniques were employed to analyze the interview transcripts. Patton (Patton, 2002) stated that analytic induction is first deductive or quasi-deductive and then inductive. For example, the analyst begins with deduced propositions or a theory-derived hypothesis. After the deductive analysis phase, the researcher uses inductive analysis to find undiscovered patterns and understanding. In addition, each participant's age, gender, education, occupation history, and income were collected and analyzed for descriptive information.

### 3.5 Authenticity and Trustworthiness

Authenticity is thought to be a unique concept in qualitative inquiry and it is an important aspect of all qualitative inquiries (Schwandt, 2001; Tobin & Begley, 2004). Authenticity in qualitative research relates to whether the technique used in the study is designed to elicit data relevant to the research questions (Denzin, 1994). Schwandt (2001) stated that researchers can show a wide variety of reality with depictions of concerns, issues, and underlying values in a given research setting. Maxwell (2005) has suggested a number of specific strategies to elevate the authenticity of qualitative research. The following strategies were used in this study.

1. “Rich” data – Intensive interviews and constant comparative method enabled the researcher to collect “rich” data for this study.
2. Respondent validation – Research participants in this study were invited to check data analysis and to provide feedback on emerging themes.
3. Intervention – Informal intervention, the product evaluation phase in this study were used as a means of experimental manipulation.
4. Searching for discrepant evidence and negative cases - The researcher rigorously examined both positive and negative cases to retain or modify the conclusion.
5. Triangulation – Four types of triangulation (Denzin, 1978), data triangulation, investigator triangulation, theory triangulation, and methodological triangulation were used in this study.

6. Comparison – Both Clark-Lindsey Village and Champaign County Nursing Home were chosen for multi-site analysis.

In addition, the researcher actively engaged in critical self-reflection about potential biases and predispositions known as reflexivity. Through reflexivity, researchers can become more self-aware and control their biases (Johnson, 1997).

Trustworthiness of the data was assessed by the following four criteria; credibility, transferability, dependability, and confirmability. Credibility (comparable with internal validity) refers to the issue of congruence between participants' perspectives and the researchers' representation of them (Schwandt, 2001). It emphasizes whether the explanation fits the description (Janesick, 2000) and whether the description is credible (Tobin & Begley, 2004). Transferability (comparable with external validity) refers to the generalizability of study. In a qualitative research, this concerns only case to case transfer which is substantially different from external validity in quantitative research (Tobin & Begley, 2004). This study attempted to increase the transferability by providing "thick" description of a phenomenon (Lincoln & Guba, 1985). Thick description enabled readers to visualize and imagine the research setting and the contents of the interviews. Next, dependability (comparable with reliability) was assessed by a process of auditing. The researchers ensured that all research processes are logical, traceable, and clearly documented (Schwandt, 2001; Tobin & Begley, 2004). Further, the researcher was aware of reflexivity, which is a self-critical process, to check if the study was still reliable. Finally, confirmability (comparable with objectivity or neutrality) was used to assess the

importance of results clearly derived from the data rather than results derived from researchers' imagination or bias (Tobin & Begley, 2004). The researcher went through a confirmability audit so that all data, such as raw data, analysis notes, synthesis products, process notes, personal notes, and preliminary developmental information, were carefully documented and organized for retrieval purpose (Lincoln & Guba, 1985).

## CHAPTER 4: RESULTS

The purpose of this study was to understand the perceptual and emotional responses of older adults to technology products. The goal was to increase understanding of how older adults particularly interact with different types of technologies and to increase our understanding of factors influencing older adults' emotional and perceptual responses. Further we tried to understand how two existing theories, the theory of diffusion of innovation and the technology acceptance model, explain the interaction between older adults and technology.

### 4.1 Demographic and Descriptive Data

We selected two different retirement communities in the Urbana-Champaign area based on their different nature. The locations were Clark-Lindsey Village (CLV) and Champaign County Nursing Home (CCNH). We selected ten residents from each location to participate in the study. The average age of the CLV participants was 83.7 and the average age of the CCNH residents was 78.9. In CLV, 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 CCNH, 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 CLV residents had a relatively higher education level, examination of the interview transcripts and the themes

that emerged from the interviews suggests 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 CLV and CCNH. Below is a brief description of the two locations.

Figure 10. CLV - Education

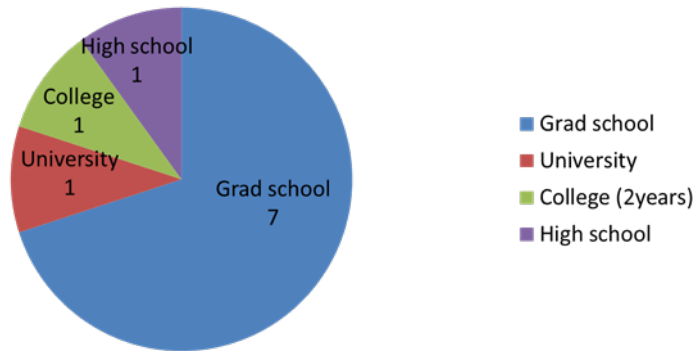
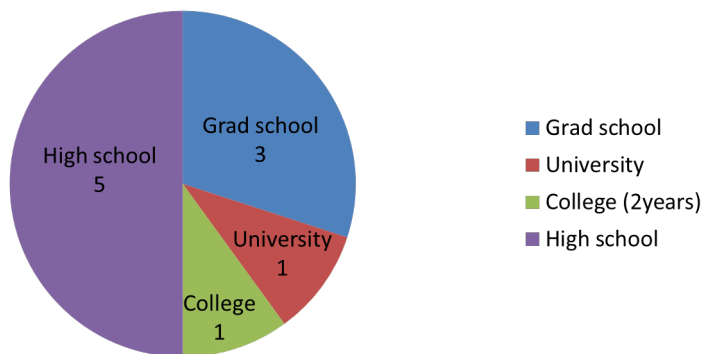


Figure 11. CCNH - Education





The first location selected for the study was Clark-Lindsey Village. Clark-Lindsey Village (CLV) is a private retirement community with approximately two hundred and fifty residents aged about fifty to ninety years old (Clark-Lindsey Village, 2012). The activity coordinator of Clark-Lindsey Village assisted us with the identification and recruitment of the sample. Most residents selected for inclusion in the study were generally well educated. The second location selected for this study was the Champaign County Nursing Home. This is a public facility that offers long-term, rehabilitative, adult daycare, and memory care services for relatively low-income older adults (Champaign County Nursing Home, 2012) . This facility has approximately two hundred residents aged from fifty to one hundred three years old with a median age of 87. Most residents have a variety of chronic diseases (Champaign County Nursing Home, 2012) . The volunteer activity coordinator of the Champaign County Nursing Home assisted us with the identification and recruitment of the sample. The significance of our settings was that CLV is a relatively affluent, private, and enriched residential community compared to CCNH which is a public facility.

#### 4.2 Major Themes

A number of theory-derived questions were developed for use in the in-depth interviews. The diffusion of innovation theory and the technology acceptance model were used to develop the interview questions. The interview transcripts were coded, categorized, and analyzed into the major themes. Three major themes emerged from the

interview process; (1) simple is better, (2) complex works for some, and (3) I do not need this. Why should I care?

#### 4.2.1 SIMPLE IS BETTER

This point of view was widely held by both residents in Champaign County Nursing Home and in Clark-Lindsey Village. Slightly more CLV residents held this position. A total of 177 statements were identified in support of the theme. This point of view corresponds with the stereotypical idea that older adults tend not to use advanced or complex technology. In this study, many older residents preferred simpler and older versions of technology instead of advanced versions of technology despite their potential benefits. In fact, those who held this position often portrayed skepticism and/or negative attitudes to advanced technology.

Rogers (2003) suggested that the population can be divided into five different groups, including Innovators, Early Adopters, Early Majority, Late Majority, and Laggard. Among these five different groups, the late majority and laggards tend to be more skeptical of new ideas and only switch to them when their use has been widely established and accepted. Furthermore, several researchers have supported the idea that there may be an overlap between the characteristics of late adopters and many older adults (Botwinick, 1973; Rose & Fogarty, 2010).

With regard to Rogers' categorization, the residents that held the position "simple is better" are thought to belong to the category of late majority or laggards, also known as

late adopters. Interestingly, each resident expressed different reasons why they prefer simple technology. In this study, Rogers' diffusion of innovation and Davis' technology acceptance model were used to interpret older adults' diverse feelings and reactions to technology and their reasons. Specifically, this study used six characteristics of innovation or new ideas that explain why individuals show different rates of adoption from the diffusion of innovation theory. The six characteristics include relative advantage, compatibility, complexity, trialability, observability and riskiness. In addition, this study used the technology acceptance model (TAM) which explains individuals' technology acceptance process. The TAM model emphasized two important factors including perceived usefulness and perceived ease of use. According to Davis these two factors have a large influence on an individual's willingness to use new technology.

Many residents expressed that they prefer to use more simple forms of technology. Many older residents who held this position felt that they did not have anyone close to them to help them figure out how to use complex technologies. Due to a lack of support, they may have perceived challenges using certain technologies while not appreciating the possible advantages. These responses may be associated with the complexity factor in the diffusion of innovation theory and the ease of use factor in the technology acceptance model. One of the more insightful statements is summarized below.

*"I wanted a simple life...I'm not going to go out and spend two or three hundred dollars on something that I have no idea what it's all about...Probably primarily I don't have anybody to help me get started...As I say I'm just a little unsure of*

*myself using things that I don't understand. And I'm not that interested to learn it on my own...I'm never going to be cutting edge..." (Male 76 CLV)*

Some residents mentioned that they prefer simple technology because they do not have previous experiences with complex technology or they have had negative experiences with complex technology in the past. Their lack of previous experiences coupled with their negative experiences may have an influence on decreasing their sense of compatibility when using advanced technology.

The following two participants expressed that they feel frustrated in the face of complexity due to their lack of experience.

*"I think it confronts some difficulty (with TVC)...Because I don't have a lot of interaction with them. Older adults are also fairly traditional so they like to keep doing what they've done and this requires them to learn some new things. And sometimes it's frustrating...A better educated person would use it. Perhaps slightly younger...And perhaps associated would use this." (Male 89 CLV)*

*"I have a simple, little cellphone that I just bought...Very basic. I haven't used a complex one (smartphone) yet because I haven't figured it out yet...Smartphone is just too complicated...Well because I probably have never had one, so I think it's just too complicated for me. I know, you young people you just think they're great. But I wouldn't use it long enough, use it enough to really remember what I was supposed to do." (Male 84 CLV)*

The following individual similarly expressed that advanced technology is hard to use because advanced technology did not fit well into her way of life. As a wife of a farmer, she had not frequently been exposed to relatively newer forms of technology. For these reasons, she felt less comfortable around complex or advanced versions of technology.

*“I would use this one (TVS). Because it’s simple...It just has six buttons, and I can handle six buttons...I’m sure it (complex version of technology) is to the younger generation but not to me...I don’t know. I am not much on reading. 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 CCNH)*

Another participant expressed negative experiences with computers in the past. As a direct result of such experiences, she prefers to use simpler forms of technology.

*“I wouldn’t know what to do with it (TVC). I have that problem with that dumb computer. If a message pops up on the board and tells me something, ninety-nine out of a hundred I don’t even know what they’re talking about. So how could I possibly do something if I don’t know what they’re talking about? That’s where I am because I haven’t been around all that stuff for all these years. Simple things are good for me.” (Male 84 CLV)*

The following resident expressed that he had a negative experience with internet shopping and it played a negative role in his attitude toward other types of technology.

The feelings expressed by this individual may also lead to negative feelings in regard to the risks associated with the adoption of new technology.

*“No I wouldn’t do internet. So why would I? I know that you can order things. I don’t even order, well I have on the Internet, but it’s very, very seldom. When I did order it, I couldn’t get ahold of the bastards on the telephone, because they wouldn’t answer the phones, so I finally in desperation ordered a pair of glasses on the Internet. Well luckily it turned out okay...If I can’t handle it my way, I won’t get it. And we definitely do not do banking on the Internet, none of that stuff. We do it our normal way. I know a lot of young people do that, but not us.” (Male 84 CLV)*

Previous insecurities with technology may result in fear with respect to trying new forms of technology. The following participant expressed that his insecurities in using technology might play a role in lowering his willingness to try new technology and decreasing interaction with technology.

*“I think...a fear comes from their insecurity of their probably lifestyle in the past. They probably have been, myself I’ve been insecure about trying new things...I would probably be a little insecure about that I mean the new generation now they do everything. They don’t even think...I think we are very much negative for that type of thing.” (Female 81 CLV)*

Residents also frequently mentioned that their decreased ability to learn was the reason why they preferred to use relatively simple forms of technology that do not require

additional learning. Their negative feelings related to the learning process may play a negative role in adopting advanced forms of technology. The following are comments made by the residents about their negative feelings toward the learning process required for the use complex technologies.

*“I would like that one (TVS) better... It’s easier to operate. There are not as many buttons. Not as many places to poke for whatever you are trying to get. It is simple. Myself, I just prefer to use this one because it is simple...I like simple one...Because everything, like I’m living now, is designed for anybody...Young people can catch on things so much faster than I can... 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 CCNH)*

*“Well my first reaction (with TVC) is that there is an awful lot on here. It’s too busy... There’s too much to deal with...And we don’t want to learn them...They’re afraid to learn...Maybe an engineer could use it...When you get a little older a lot older, it’s harder and harder to learn new things.” (Female 88 CLV)*

Some individuals expressed concerns in relation to their physical condition due to their advanced age. Older individuals’ physical or mental decline or concerns regarding their current physical or mental condition may play a role in their preference of simple technology. They believed that their declining physical and/or mental conditions due to their age may have limited their access or actual use of technology. These responses may have influenced individuals comfort levels with specific technologies. For example;

*“This one (TVC), 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 CCNH)*

*“Probably elderly people would use this (TVS)...Because it is simple for us. You just push the little red button...Because when they get older, their functions and stuff don’t work right. Your eyesight...For me, I will stick with that one (TVS)”*

*(Female 69 CCNH)*

*“It’s just too much cripes...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 CLV)*

A few residents described their lack of opportunity to experience new technology as an issue as well as their isolation from technology. These reactions suggest that many older residents may perceive less trialability and observability of technology.

*“I think a lot of technical stuff is being so pushed away from us; it’s been taken away from us. They have done away with space. There is a lot more out there to discover. There is a lot of stuff under the sea, under the ocean. But I feel we are being held back. They don’t want us to grow. They don’t want us to expand.”*

*(Female 69 CCNH)*

*“I don’t have any place to find new technology...I don’t know anybody well enough, at least around here...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 CLV)*

Some of individuals have expressed their frustrations or anxieties about using complex or advanced technology. These feelings may have come from their perceptions of complexity and lack of ease of use. Correspondingly, they tended to respond negatively to their ability to figure out how to use various forms of technology.

*“Where most of these buttons as I said I don't understand what they do or how to use them... Much too complicated...When I sit down in front of the computer and try to do something I have never done before it makes me nervous. 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 learning about new technology very fast.” (Male 76 CLV)*

*“I can't...I can't master them (with complex devices) yet...I don't know which button to push, so many buttons... Buttons are too difficult to push. And it's confusing...” (Female 98 CCNH)*

The following older adults expressed a high level of anxiety when using technology without assistance. Lack of support may increase older adults' anxious feelings when using technology.

*“If somebody gave me one I would be very nervous as to even start unless they stayed with me...I wouldn't buy it because I wouldn't understand what I was*

*getting...I'm not the type of person who would try it on my own. I wouldn't, even though I might like having one of these, I wouldn't ever go out and buy one because I don't know anything about it." (Female 88 CLV)*

Furthermore, a few individuals have expressed strongly negative feelings or fears regarding the use of complex technologies. These responses seem to be closely related to prior negative experiences. These negative feelings or fears may decrease their comfort level and increase feelings of complexity. It may also increase the feeling of riskiness when using advanced technology. For example;

*"When I first look at it (TVC), it looks complicated...I would be intimidated right off using it... When they (with her previous TV remote) break down I have a terrible time knowing how to fix them...I was very afraid to experiment... I'm intimidated with technologies and don't do it." (Female 81 CLV)*

*"I have a laptop... it is not hooked up. But I play games on it. They are for games. And then I keep my banking records and stuff in it, but do get out there on Facebook and Google and all that. I don't do it...because I am so intimidated by them because it is something that I can't control. And I am afraid I will go out there and I will mess or screw something up. Especially on Facebook or something like that, I will hit something wrong and screw something up..., I feel some risk..." (Female 69 CCNH)*

#### 4.2.2 COMPLEX WORKS FOR SOME.

This point of view was held both by residents in CCNH and CLV. A total of 129 meaningful statements were identified in support of the theme. Interestingly, twice as many female residents held this position. Based on this study, older adults frequently preferred simpler forms of technology, however, some older adults who were in appropriate circumstances for the use of advanced or complex forms of technology sometimes choose them over simpler technologies. Older adults who held this position tended to show their willingness to figure out how to use complex technologies. They also expressed relatively less difficulty in using complex or advanced forms of technology. Although the total number of residents supporting this theme (N9) was less than the total number of residents supporting the first theme (N15), they clearly expressed their willingness to use complex technology. Furthermore, most residents who supported this position tended to recognize fewer advantages and less perceived usefulness with regard to simple technologies, whereas they recognized the opposite in relation to complex technologies.

With regards to Rogers' categorization, the residents that held the position "complex works for some" are thought to be relatively earlier adopters. Importantly, both early adopters and early majority tend to adopt new technologies or new ideas earlier than late majority or laggards who generally adopt new technology or new ideas after the average members of society. Although all participants in our study were older adults ranging from 67 to 98, some older residents showed some of the characteristics of earlier adopters.

Most of the residents who chose to use more complex forms of technology expressed that they preferred to use them because they clearly perceived more advantages or functions than those offered by simpler forms of technology. The most insightful statements are summarized below.

*“I would probably pick that one (TVC) there... Well because there are many more possibilities of things it does. It'd take a little while to get used to but I, it plays the DVDs and all that TV and VCRs...Yes. This has many more possibilities of using different... I guess it (PEC) has more possibilities although I don't use all of them. It feels like it is more confident machine. I think it's good....because it's a good motivator for people to learn to walk. To count the steps and be more aware of what they're doing, how much they're walking during a day... This one is more accurate.” (Female 84 CLV)*

*“To me, it (TVS) is just too simple. There is not enough variety....it doesn't give me the opportunity that this one (TVC) does... I think of my wife (with TVS). She has the beginning of Alzheimer's, and she has a device for her television set that is not as complicated as this...well this one (TVC) would be more advantageous... I just would rather use this one (TVC)” (Male 83 CCNH)*

*“I'd probably go with that one... Because I have the extra equipment and stuff that I would want to use...I would prefer this (PEC)...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 (PES) doesn't...” (Male 84 CLV)*

Some older adults would accept newer forms of technology if new technology fit well into their current needs or lifestyle. For example,

*“This (TVC) has a lot more functions on it. Even though I would not use all of these functions, I would use enough that...That (TVS) is just useless...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... And here you have whole bunch different functions... Yes I find it very useful...I like this one (PEC)... it has more functions... Well, that would be advantageous because I need to have some sort of program of walking, and this would be helpful there, while this one (PES) is just counting steps...I think this (PEC) is more likely to help me establish and keep my goals, and this (PES) is not.” (Female 67 CCNH)*

*“Well for me I’d prefer this one (TVC)... Because I often play DVDs or take movies, rent from Netflix. So I have things I could do with this that I couldn’t do with that (TVS)...I think complex one better suits my lifestyle...it has more functions and it better suits the things that I do... It (PEC) is one that would be of more interest to me because I change the mode and adjust it for the distance of my step and then I can also quickly return it to zero. Well I think this fits better in my lifestyle because I want more information when I’m walking or exercising than that (PES) would provide.” (Male 87 CLV)*

Some individuals mentioned that they prefer complex forms of technology due to their past positive experiences. Such positive experiences with advanced and complex

technologies help to explain why they prefer those forms over simpler forms. Furthermore, their positive experiences may play a role in making them more comfortable with regard to complex or advanced technologies. These positive perspectives expressed by older individuals may have an influence on their conclusions regarding comfort levels and ease of use. For example;

*“I am sure I can figure it (TVC) out...I can figure things out really quick. I am a retired electrician, so a lot of things my wife cannot figure out, I can figure out because of the training I have and the training she has which she mostly picked up.” (Male 80 CCNH)*

*“I am sure that it (TVC) is not as complicated as it looks. And it would take me, even without any instruction, twenty to thirty minutes to figure it all out and use it. I would use this over that other one...because I have always liked something new. I have always wanted to try something new... I enjoy computer... I built my own back when I was a teenager. Buy the parts and put it together. It was very simple, of course. Then I had a Commodore 64 and then a Commodore 128... I have been with Macintosh ever since...” (Male 83 CCNH)*

The following individual expressed several reasons as to why she prefers complex forms of technology. Her active personality, positive attitude towards the learning process, and positive previous experiences are factors related to her inclination toward complex technologies.

*“I am nosy. I like to find out new things and how to work them. And I think that is the way the world is going. And so, I don’t want to get left behind. I want to know how to live in this new world...if you turn me loose with this with no instructions, I would probably mess it up. But with instructions, I could probably do that... I’m comfortable with technology... I have been able to use my computer. I bought the Nook. I have a Kindle. I have a smartphone. It fascinates me what it will do for me... I do a lot email... To me, to be able to talk to friends who live far away through the email, that’s important to me...Also, I worked for the university... I think I have always been into it (new technology)... ” (Female 75 CCNH)*

Similarly the following subject discussed her preference to use complex forms of technology due to support received from family members. Such support kept her from feeling overwhelmed when using complex technology while allowing her to have more opportunities to be exposed to newer and more advanced technologies.

*“I’m quite comfortable with technology. I use computer. If I have problems with that I call my husband... So far I’ve got a helper...Our son is really a computer guru and he helps pick out, and gives us ideas of what is good and bad... For us it’s important... We use like the computer and the iPad everyday, especially the computer. We also have a Kindle, book thing... so I’m sure he’s been a big influence in my being up with what I am....We have computers and iPad...that we use... My husband is actually the one who puts in all the apps and what not to it...” (Female 84 CLV)*

The following individual also mentioned her preference to using new technologies due to the availability of an instructional program. Instructional programs or supportive classes may help older individuals to be more inclined to use complex or advanced forms of technology. In this case, more opportunities to be exposed to different technologies in the facility where she lives could possibly increase her feelings of trialability and observability of technology.

*“Oh I have lots of fun with Nintendo Wii...We have a good (activity) group down there, Tuesdays and Thursdays, and it is fun to try and golf some...Amanda (activity teacher) comes...I like what Amanda does...It has lots of interesting things....For fun and also a little bit of exercise...I have no fear with learning this kind of things.”*

*(Female 84 CLV)*

#### 4.2.3 I DO NOT NEED THIS. WHY SHOULD I CARE?

This final perspective was also held both by residents in CCNH and CLV. A total of 86 meaningful statements were identified in support of this theme. Interestingly, twice as many male (N= 7) residents held this position compared to female residents (N=3). Among residents that held the position, “I do not need this. Why should I care?” some suggested that they often choose not to use technology simply because they do not see any benefits for the device regardless of its complexity. Many residents held this position regarding the pedometers that were discussed in the interviews. They had concluded that all pedometers were worthless whether they were simple or not. The most insightful statements supporting this theme are summarized below.



*“It (both PES and PEC) wouldn’t affect my life. Right now, I never have been interested in knowing how far I can walk. If I was in a position where my job depended on walking or exercising then I might want to use one. But I don’t. I can tell when I go a mile by the blocks I have walked, but I don’t really need to know... I don’t need it. I wouldn’t need either one of these, no... I don’t have any desire to use those because I don’t really want to know how far I travel.” (Male 82 CCNH)*

*“I see no advantages to them except if someone needs to be in shape and they want to see how many steps they have run... I personally wouldn’t use them... Because I don’t care how far it is from there to here or here to there, whichever it is, because I have to go there. So, who care how many steps it takes?... So, they don’t prove nothing.” (Male 80 CCNH)*

The following individual expressed that when a given technology did not meet his needs, he saw no reason to use it whether it is simple or complex.

*“They (both PES and PEC) don’t help me with things like that. They don’t help me with things I would really like to know like pulse rate, blood pressure, and things like that. They make those things, but they are highly priced... I thought they were kind of a trick thing to see what they’d do, and I would look at them for a bit and say I really don’t need this. So they didn’t affect my running really. Like I told you, they don’t need to tell me how far I have gone because I already know. And that is all they do. They are worthless to me... I don’t have any use for those really... To me, they are kind of useless... Just like when you go down to the mall*

*and you walk with your friends and you know it's a quarter of a mile around the mall. So what do you need that for?" (Male 80 CCNH)*

Some individuals specifically mentioned that they are not interested in using pedometers because they are not physically active. For this reason, they perceived that pedometers would not fit into their lifestyle so they would not need one. Further, they did not see the potential benefits of using pedometers as a tool to motivate them into staying physically active. Their negative attitude toward physical activity may play a role in decreasing the feelings of compatibility, relative advantages and perceived benefits of using a pedometer.

*"Probably only if I were on an exercise program that required me to keep track of how far I had walked that day. I am certainly not running at my age... I wouldn't use it unless I was required to do it... I am not really interested in how far I have walked. I am just not. I am not an exercise buff... I'm not exercising... So, I don't have any use for the device at all. I am not saying it is useless. For someone else, it might be important, but not for me." (Female 77 CCNH)*

*"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 CCNH)*

A few residents expressed that a lack of experience or negative previous experiences may have resulted in their ambivalence towards new technology.

*“I have owned them. I have used them for a day or two. I find them pretty much totally useless... I just went down to the park. I ran home from work. Or running a short race with some people. I already knew how far I was going, so I didn't have any use for them...” (Male 80 CCNH)*

*“Since I haven't used a lot of technology instruments, I probably don't have as much knowledge as if I were using them, so I am probably below knowledgeable level because I don't use them...” (Male 82 CCNH)*

A few individuals suggested that they were reluctant to adopt new technology because of a concern about cost in relations to their current financial condition. Their concerns about cost could have increased their feelings of risk and relative disadvantages of adopting new technology.

*“Cost has to do with it. Everybody should have a budget... But can you afford it, no... 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 CCNH)*

*“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 CLV)*

Finally, two residents expressed their entire frustration about all forms of new technology. They did not believe that technology could change their lives and they showed no inclination towards any types of technology.

*“I understand how technology has changed. Everything is so much better like your cellphone. I can’t think of anything else right now. There are so many different ways, you know, you can converse, you can use it for business purposes. But it has not affected my life...So technology is not that important. When they can improve things, yes it will affect my life, but basically my life is not going to change... I realize that it has changed for better for some people, but for me it hasn’t changed much at all... I am not as physically active as I was when I was in my thirties. I did a lot of things from an exercising standpoint...I played golf... But the technologies don’t change for me right now...because my life has changed considerably...I am still living a very simple life...” (Male 82 CCNH)*

*“You have to have technology. But in my life, it doesn’t make any difference. My quality of life depends on what I can get done here. I have to be cared for. Somebody has to do something. Just like what is going to happen now. I have to have three nurses come in...So I don’t know. And I don’t care... the old men don’t like to pay for it...” (Male 78 CCNH)*

The following individual focused on the difficulty of learning new technologies. For this reason, he did not to use any newer forms of technology but preferred to use existing forms of technology. His negative feelings towards learning about new technology may be closely associated with its higher complexity levels and lower ease of use.

*“I’m not overly enthused about it. At my age it’s more difficult to learn... It’s part of the aging process...I think the hardest part is learning new things. Maybe 20*

*years ago I would have been enthusiastic about learning more complicated machines. But now that 20 years later, it's more difficult for me to master though so I don't get the same enjoyment out of it. In fact I feel sometimes it's more of a chore. Not something that I especially enjoy. (Male 82 CLV)*

Some residents stated that many new technologies did not fit into their lifestyle. This suggests that some older adults may want to keep using what they have used for most of their life.

*"I think it's good to know all of the new technology. But I don't like the book on the computer. E-book. I don't especially. I like to read real books. I mean, it does probably have a lot of advantage of knowing new technology, but I don't feel the need..." (Female 80 CLV)*

*"You see all these books here. I prefer to hold a book, and smell the book, and turn the pages and so on. I haven't any great urge to get the Kindle although I can see the advantage of it. You'd be able to read it laying down in bed, whereas the heavy book there would be impossible to read while laying down and holding it up... 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 use the ordinary technology thing to, for my things that I learn. Like watching a taped lecture is one of my favorite to do or reading a book. Those are things which I like and am comfortable with... I enjoy other things better" (Male 82 CLV)*

The older adults who held the position, “I do not need this. Why should I care?” suggest that we cannot simply categorize all older adults conveniently into one of Roger’s five groupings. For example,

*“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 CLV)*

*“I prefer the pedometer... This is...much advantageous for me because I want to know the steps I take.” (Female 80 CLV)*

Although it looked like that she did not prefer to use technology in general, she expressed her preference to use some forms of technology due to her needs and personal preferences. Older adults’ preferences could possibly differ because their value systems regardless of characteristics of technology. As stated above, it is hard to classify all older adults’ attitudes toward technology into a single category. The diverse group of older individuals interviewed explained why they sometimes choose not to adopt some forms of technology but were inclined to adopt others. In this study, some older adults clearly preferred simple or older forms of technology and the other older adults preferred complex or advanced forms of technology. Some older adults expressed their indifference or dislike in using technology in general; while others expressed a preference to certain forms of technology but not others. Throughout this study, it was also evident that many older adults showed very diverse perspectives with regard to their feelings about technology. Therefore, understanding the diverse viewpoints of older adults to a variety

of different technologies is extremely important. Finally, it is important to note that both male and female participants held the three major themes that emerged from our study and that there were no fundamental gender differences observed in our study.

## CHAPTER 5: DISCUSSION

### 5.1 Discussion

This study sought to understand the emotional and perceptual responses of older adults towards new technology. The primary goal of this study was to increase our understanding of how older adults respond to diverse types of technology and what factors are instrumental in the adoption or non-adoption of new technology in older populations. This study selected two distinctly different retirement facilities in a mid-sized Midwestern town in order to improve our understanding of how different older individuals respond to technology. We used a qualitative research design, including product personality profiling and in-depth interviews, in order to gather rich and authentic data.

Recently, the rapid growth of the older populations and increased life expectancy have led many researchers to develop an increased interest in technology use among older adults and the potential for new technology to play a role in increasing quality of life among older persons (Demiris et al., 2004). A number of studies have demonstrated that technology may have the potential to improve an older adult's quality of life. For example, Mitzner et al. (2010) showed that many diverse types of new technologies have the potential to help older adults to be more physically, psychologically, and socially active. Although a variety of technologies may have the potential to improve older adults' quality of life, older adults are often less likely to use new technology and are more likely to experience difficulties when trying to learn how to use new devices (Koppen, 2010; Melenhorst, Rogers, & Bouwhuis, 2006; Ziefle & Bay, 2005). Unfortunately, relatively



little is known about how older adults specifically respond to new technology and why many older adults decline to adopt new technology. The study of emotional factors in older generation's technology adoption has received relatively little attention in the area of aging research (Lawton, Moss, Winter, & Hoffman, 2002; Melenhorst et al., 2006). Accordingly, increasing our understanding of specific reasons and factors why older individuals selectively adopt some innovations but not others is very important. In fact, finding an answer to this question was a guiding principal behind the development of this study.

This study recruited research participants from two different settings that have quite different characteristics. Clark-Lindsey Village is a relatively more enriched facility than Champaign County Nursing Home (Malavasi, 2010). Ten participants from each location were interviewed. Both inductive and deductive analyses were used for interpreting and analyzing the interview data. During the early stages of this study, the data was analyzed with an inductive approach in order to discover patterns, themes, and categories. Once patterns, themes, and/or categories were established through inductive analysis, deductive analysis was performed in order to affirm the authenticity and appropriateness of the inductive analysis (Patton, 2002). 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?

The first major theme that emerged in the present investigation was older adults' preference to use simple technology. Rogers (2003) 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 technology. 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.

First, 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, many seniors feel challenged when using certain types of newer technology. Previous research has also found easy access to help and technical support to be an extremely important factor in older adult technology adoption decisions (Selwyn, Gorard, Furlong, & Madden, 2003a). An older adult's willingness to use new technology has been found 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 (Igarria, Parasuraman, & Baroudi, 1996). Similarly, Rhee and Kim (2004) proposed that social support, including friends and family, plays an important role in the adoption of new technology. 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 older adults gave for their preference for simple technology was previous experience. 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 new forms of technology. In this study, one of the participants mentioned that he did not have much prior interaction with advanced forms of technology and as a result often encountered difficulty when trying to use new items. Many 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 and 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. Moreover, in this study, one of participant talked about a negative experience he had with internet shopping. In his case, negative experiences with technology played a role in reducing his confidence to use other forms of new technology (Cassidy & Eachus, 2002). Similarly, Lu et al. (2003) stated that positive experiences with similar forms of technology often play a positive role in building favorable attitudes toward new technology.

The third reason older adults gave for preferring simple technology was compatibility 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. 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. That is why she felt less comfortable around complex and advanced forms of technology and comfortable with simple things. 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. Vijayasathy (2004) similarly reported the importance of compatibility in on-line shopping adoption. From the consumer's perspective, perceptions about the compatibility of a new technology to one's lifestyle appear to be one of the most important determinants of technology adoption. With regard to innovation and one's lifestyle, Rogers (2003) 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.

The fourth reason behind older adults' preference for using simple technology was their perception that they had a decreased ability to learn new things. In this study, older residents who held this position tended to avoid additional learning. 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. 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, and 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 et al., 2006; Rogers, Kristen Gilbert, & Cabrera, 1997). In this study, 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. 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 or accepting new technologies.

The fifth reason older adults' preferred simple technology was their isolation. Many older adults may perceive fewer opportunities to assess the trialability and observability of newer technology. "Trialability" is a term coined by Everett Rogers that

refers to the notion that the more opportunities an individual has to experience new ideas or technologies may accelerate the persons' willingness to adopt a technology. Similarly, observability reflects the notion that if innovations are visible to others, the innovations have more likelihood to be adopted by individuals (Rogers, 2003). One of individuals in our study stated, "I don't have access...I don't have any opportunity to use new technology." This suggests that the individual did not have enough prior opportunities to use advanced technology and did not have enough chances to see technology in use by the others close by. Although, many researchers 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. (2003b) stated that it is extremely important to have access to technology-using friends, family, and neighbors. Additionally, Czaja and Lee (2007) stated that age-related changes in physical and cognitive abilities may limit older adults' opportunities to access to new technology. Furthermore, some researchers pointed out that a lack of age-appropriate technology education or instruction may be a major barrier to older adults access to using new forms of technology (Czaja et al., 2006b; Xie & Bugg, 2009). 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. According to Barker (1938), a frustrating situation is one in which obstacles including physical, social, and environmental prevent the satisfaction of one's desire. As stated before, older residents' physical, social, and environmental situations in response to the technology adoption process may have resulted in some significant frustration. Other researchers have also found that frustration can cause people to fail and therefore affect their willingness to learn new technology (Juutinen & Saariluoma, 2012). Technology anxiety describes a negative or stressful emotional state associated with thinking about or using new technology (Catherine & Charness, 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 a perceived lack of ease of use may reduce an individuals' willingness to adopt a new idea or technology (Rogers, 2003). Many researchers emphasize that avoiding feelings of frustration or anxiety in older adults is a very important element for technology adoption (Catherine & Charness, 1995). Technological anxiety often causes people to reduce the amount of time spent using certain forms of technology (Doronina, 1995). In this study, some participants expressed fear of technology. One individual described technology use as "I would be intimidated right off using it....when they break down I have a terrible time knowing how to fix them...I am very afraid to experience it". This type of negative reaction to technology is very common in older populations. Timmermann (1998) mentioned that when using a computer, hitting the wrong key and then having the feeling that you will not be able to fix the problem when combined with the feeling of potentially breaking a computer could

scare people of all ages, particularly older generations. Bowe explained that older adults may be reluctant to use potentially useful forms of technology because older adults fear them, do not understand them, and do not want to ask extra help to operate them (Bowe, 1988; Morris, 1994).

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 older adults often prefer to use simple technology, there are situations where older adults are 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 Roger's theory of technology adoption may oversimplify the relationship that older adults have with technology. Most 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 prefer to use advanced or complex versions of technology.

First, many older residents who held this position tended to see relatively more benefits of using advanced technology. This may be due to an increased perception of the relative advantage or benefits when using them. Relative advantage refers to the perceived advantage a user feels about a technology (Rogers, 2003) and perceived benefits are defined as an one's subjective evaluation of the potential gains related to a new technology (Brown, 2005). Many 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., 2006a; O'Brien et al., 2008). In the perspective, some



researchers believe that perceived benefit is one of the fundamental aspects of the consumer decision-making process. Moreover, a consumers' perceived benefit is often positively associated with a consumers' trust in a given product. 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). According to Melenhorst et al. (2006), older adults might not be motivated to adopt new skills or new ideas because they do not perceive any benefits from using them. The perception of a lack of relative benefit might play an even more negative role in adopting new technology than a lack of previous experience. 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 perceived benefit means to older adults (Melenhorst, Rogers, & Caylor, 2001).

In this study, some older individuals expressed their preference for advanced and complex forms of television remote controls because they are currently use many different media devices and would like to control all of them through the use of one remote. In this case, older residents who held this position may consider the compatibility of television remotes with their current needs and lifestyle. With regard to this reaction, O'Brien et al. (2008) mentioned that compatibility of the technology with older adults needs and lifestyles may facilitate technology adoption. For example, although video chat

technologies, such as Skype, require a significant learning curve to use them, some older adults are willing to invest this time because of their physical distance away from their children or grandchildren coupled with their urge to stay connected to them (Raffle et al., 2011). In this case, meeting with family members using video chat technology could be one of the most enjoyable activities in an older adults life and may satisfy their need to stay connected with loved ones (Rogers, 2003).

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. These positive factors may have had an influence on their comfort level and ease of use when referring to new technology. Others 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) also stated that potential users with more previous experience tend to spend more time exploring new technology. Many researchers 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). A study by Sarker and Wells (2003) suggested that positive previous experiences with technology help to build favorable attitudes and/or behaviors when users encounter new technology. Some researchers suggest that personality plays a role in technology adoption (Vishwanath, 2005). Early adopters may need to possess a personality characteristic that accepts high levels of ambiguity in

technological decision-making (Rogers, 1995). 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).

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. One individual described direct help she received from her son. She said that “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.” Lack of help and/or technical support from family may play an important role in building negative attitudes to complex forms of technology (Selwyn et al., 2003a). Support from family members may help to prevent older adults from feeling that a 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. Trust is often based on personal relationships and face-to-face interactions (Kim et al., 2009). It may also play a positive role in shaping older adults’ feelings of comfort with technology. Instructional programs and classes may provide opportunities for older adults to experience diverse forms of technology and consequently older adults may be more inclined to use advanced forms of technology. For example, Rogers, Fisk, Mead, Walker,

and Cabrera (1996) reported that technological training played a positive role in older adults ATM machine use (Rogers, Fisk, Mead, Walker, & Cabrera, 1996). Thus, technological education or training programs can improve older individuals' inclination to use technology (Mitzner et al., 2010).

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 technology regardless of its complexity. For example, most residents described both simple and complex pedometers to be worthless independent of their technological advancement. More specifically, some individuals mentioned that pedometers were simply not compatible with their lifestyle. Because many of the seniors interviewed were not regularly physically active, they were indifferent about using pedometers. A few individuals suggested that they were reluctant to use technology because of a concern 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). Melenhorst et al. (2006) suggest that cost reduction may possibly encourage older adults to use and adopt new technology. Two individuals in our study expressed their frustration about all forms of technology.

They did not believe that technology could improve their life and showed no inclination toward any type of technology. In the field of educational gerontology, some researchers have also reported finding diverse sources of frustration with technology use. They include the length of time to learn technological skills, lack of time to practice lessons, fear of technology, and unexpected outcomes. 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). Moreover, one individual in our study expressed difficulty in learning newer forms of technology. For this reason, he did not want to use any newer forms of technology, but rather wanted to remain using existing forms of technology he was familiar with. 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 (Melenhorst et al., 2006). This theory may well explain why some older adults are reluctance to learn newer forms of technology and prefer to use existing technology.

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 several 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 CLV)*

*"I prefer the pedometer... This is...much advantageous for me because I want to know the steps I take." (Female 80 CLV)*

Although it appears that she dislikes some forms of technology, she expressed her willingness to use other forms of technology because of her desires, interests, and personal preferences. In this case, we cannot easily categorize her technology preference based on Rogers' five categorizations (Rogers, 2003) because she is inclined to use some form of technology and not others. There have been many studies which have addressed the issue of whether older adults are laggards or not. Some studies suggests that older adults are more likely to be later adopters than younger generations (Czaja et al., 2006b; Czaja & Lee, 2007; Gilly & Zeithaml, 1985a; 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. Importantly, this theme implied 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.

Unfortunately, little is known about context-related perceived values of older adults in response to new technology (Melenhorst et al., 2001). In relation to older individuals' unique personal circumstances and situations, the field of ergonomics emphasizes the need for an understanding of an older individual's everyday 'real' and 'authentic' perspectives toward technology. This approach may provide insightful and meaningful information (McDonagh & Thomas, 2010; Shin, Benson, & McDonagh, 2011). This individualized, authentic information about the relationship between older individuals and technology may help product developers and designers when they produce new products or technologies.

The six factors listed in Rogers' theory provide important motives for adopting new technology. However, the third major theme identified in our study is not easily explained by Roger's six factors; 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. In this study, some individuals suggest that they adopt or avoid technology because of a lack of interest. Sometimes they just do not care about a particular technology. 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. Although, a few prior technology adoption studies have attempted to explain the impact of socio-cultural influences, little is known about the role that socio-cultural factors play in the diffusion and adoption of new technology (Deligiannaki & Ali, 2011). In certain societies, some innovations are never

adopted at all while others are quickly adopted. For example, based on Confucianism, South Korean children are obligated to take care of their parents in terms of physical, social, and economic support. This unique cultural context may slow down the dissemination of retirement facilities in South Korea (Kim, Hayward, & Kang, 2012). It is clear that social and cultural contexts play a role in the adoption of new ideas (Vannoy & Palvia, 2010). Therefore, understanding the older individual's unique situation and cultures is extremely important.

Two factors from the TAM model were found to be important reasons for adopting technology, specifically, perceived ease of use and perceived usefulness. Perceived ease of use was an important factor but it was not the only factor involved in technology adoption. Perceived ease of use varied by situation and from individual to individual. Others have suggested that older people tended to reject technology use more than any other age group due to their needs and expectations (Conci et al., 2009). Need or desire may be a strong determinant in older generations' technology adoption. In addition, needs or desires may lower an individuals' perceived ease of use in technology adoption. For example, video conference technology, such as Skype, may have a lower ease of use for older individuals. However, many older adults are still prepared to learn Skype due to their needs or desires to see their family who live far away from them (Raffle et al., 2011). In this study, the third theme "I don't need it. Why should I care?" strongly supports the importance of perceived benefits by individuals. The larger the perceived benefits when coupled with a higher level of perceived ease of use is likely to play a positive role in older adult technology adoption. However, the TAM model does not do well in taking



into account the socio-cultural impact on an individual's technological decision-making. This could be seen as a limitation of the model (Renaud & van Biljon, 2008).

## 5.2 Summary, Recommendation and Suggestion

When considering technology adoption, understanding older adults' perceptions and feelings is important since they can be a contributing factor when trying to motivate this age group. In this study, diverse elements, including lack of help or support, age-related declines in physical condition, lack of opportunity, feelings of frustration and anxiety, fear, lack of compatibility with lifestyle, lack of benefits, lack of needs, lack of experience or negative previous experience, a perceived lack of ability to learn, and a concern over cost emerged as factors that influence older individuals decision-making with regard to technology adoption.

Eight factors from innovation theory and the TAM model were useful in understanding older adults' preferences toward technology. The main contribution of innovation theory is to provide explanations for how, why, and at what rate new ideas or technologies spread out in a given society (Rogers, 1995). In this study, six factors from the innovation theory, including relative advantage, compatibility, complexity, trialability, observability, and riskiness emerged as important elements influencing older individuals' perceptions and emotions in response to new technology. In this study, older participants' diverse reactions as to why they adopt or do not adopt new technologies were generally well explained based on these six factors.

The TAM model also attempts to explain an individual's response when exposed to a new technology; this model emphasizes perceived usefulness and perceived ease of use (Davis, 1989). In this study, these two factors were also found to be important determinants. However, there were some factors which cannot be explained by the above theories because technology preference can vary from situation to situation and from device to device. For example, in this study one individual expressed her dislike using technology in general. However, she expressed her willingness to use a pedometer regardless of its complexity because she wanted to be physically active to maintain her physical condition. This case suggest that when an older adult's situation or circumstance changes, he or she may express different an attitude towards technology. For example, in this study, an individual expressed few perceived benefits to using a pedometer because of a recent knee replacement surgery. Currently, he is not physically active because he still feels a little pain in his knee. However, it is possible that when he recovers from the operation, the individual might possibly see an increased relative benefit toward using a pedometer. Furthermore, different devices are likely to have different perceived values and older individuals may perceive devices differently due to their situations. Values are defined as individuals' fundamental beliefs with regard to the desirability of behavioral choices (Jehn, Chadwick, & Thatcher, 1997). Thus, this study emphasizes the importance of understanding an older adult's personal circumstances, situation, and stories. Each older individual has a unique value system. Therefore, one needs to understand older individuals' personal situations and circumstances in order to gain insight with respect to why they choose to use or avoid certain forms of technology.

Older adult's preferences toward technology cannot simply be standardized. They need to be understood in the context of both diverse perspectives and situations and the diverse characteristics of different forms of technology.

### 5.3 Limitations of the Study

In this study, the age range of the participants was 67 to 98 years. This wide age range, when coupled with the small sample size, resulted in a very diverse and heterogeneous sample. The qualitative nature of the study, by design, limits the degree to which generalizations and inferences can be drawn to the older adult population either in the United States or in other countries. While the general themes that emerged from this study can be considered to be broadly informative and provide a roadmap for future research, additional follow-up quantitative studies will be needed before it is possible to generalize the findings of the current investigation to the older adult population as a whole.

### 5.4 Suggestions for future studies

Given the complexity of the older individuals' decision-making processes in technology adoption, there should be efforts that consider older adults' individualized perspectives with regard to their specific situation. Although older adults have long been regarded as a homogeneous group in relation to technology adoption, many current studies have asserted that they are much more heterogeneous than was previously thought

(Meneely, Burns, & Strugnell, 2009). Therefore, the acquisition of authentic knowledge about the life experiences of older adults is important to expand our understanding on what older adults really need and want (McDonagh & Thomas, 2010). Insights gained from qualitative studies will help us to understand older adults' unique reasons as to why they adopt or decline certain forms of technology. Additionally, it will help industrial designers to generate products with more appeal to older adults (Cardoso & Clarkson, 2012).

Further, future studies are needed to explore the potential role that technology plays in assisting older adults make healthy lifestyle choices, including regular physical activity and healthy aging. New technology has the potential to improve older adults' quality of life, provided they are willing and able to adopt it (Jung, Li, Janissa, Gladys, & Lee, 2009). Further, technology may motivate older adults to live healthier lives (Consolvo et al., 2006; Intille, 2004). For example, King et al. (2008) saw interactive hand-held phones and tablets as a potential physical activity promoting strategy among older adults. Recently, some researchers focused on physical, mental, and social benefits of using Nintendo Wii in older generations (Pollock, 2011; Wollersheim et al., 2010). Unfortunately, despite increased use of technological devices in the general population, older adults are still less likely to use new technology (Czaja et al., 2012). Therefore, it will be very worthwhile and meaningful to understand older adults' diverse and individualized perspectives toward a variety of technologies that promote their healthy lifestyle and aging.

## 5.5 Conclusion

This research was conducted to understand the emotional and perceptual responses of older adults to technology products. The primary goal of this study was to increase our understanding of how older individuals interact with different forms of technology and to increase our understanding of diverse factors impacting older adults' emotional and perceptual reactions. Three major themes emerged in this study; (1) simple is better, (2) complex works for some, and (3) I do not need this. Why should I care? The factors that emerged as influencing older adults' responses to technology were broadly consistent with some of the elements of the diffusion of innovation theory and TAM technology acceptance model. However, this study found that both of these theoretical explanations need to be adjusted in order to take into consideration older adults' personal circumstances, situations, and stories. These individualized factors have a strong impact on older adults' emotional and perceptual responses to technology products. Therefore, it is crucial to make an effort to understand both older adults' individualized values and the diverse characteristics of different forms of technology. The findings of this study contribute to our understanding of the interaction between older adults and a variety of technologies.

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