GERONTECHNOLOGY FOR FALL PREVENTION, DETECTION, AND MONITORING: EXAMINING THE DIFFUSION OF TECHNOLOGY AMONG OLDER ADULTS FOR AGING-IN-PLACE

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Abstract: Gerontechnology has been studied and developed to support older adults' desire of aging-in-place, providing independence, autonomy, quality of life, and also by reducing costs with health services. Over recent years a number of gerontechnologies for fall prevention, fall detection, and fall monitoring have emerged to promote aging-in-place at home. However, the literature does not make clear what influence older adults to adopt or reject the use of such devices. The purpose of this study was to examine the diffusion of gerontechnologies for fall prevention, detection, and monitoring among older adults for aging-in-place based on the five stages of the innovation-decision process. The predictors of the first three stages – knowledge, persuasion, and decision – were examined and a theoretical framework was developed with the main stages from the original model (knowledge, persuasion, and decision) and variables related to older adults' characteristics, relationship with technology, aging-in-place, and fall concerns were included in the model. A self-administered survey was conducted with 331 older adults in the state of Oklahoma. The questionnaire consisted of three sections: talking about yourself, talking about your home, and talking about technology, respectively. Path analysis through multiple regression was used to test the proposed model with 15 hypotheses organized in eight groups. The main path of the model (knowledge, persuasion, and decision stages) appeared to have the most significant relationships, while the variables that influence the main path would vary from type to type of fall-related gerontechnology. Among the variables around the main path, technology readiness was significant at least in one stage of the innovation-decision process for fall prevention, detection, and monitoring gerontechnologies. In addition, sources of information were correlated to the different stages of the process, however, it had the highest significance to the persuasion stage. This study contributes to the literature on interior design by addressing the issue of falls in the home environment, emphasizing older adults' desire for aging-in-place, and by investigating the diffusion of gerontechnology that could help older adults to overcome fall concerns, attaining aging-in-place for longer. In addition, interior designers should consider the inclusion of gerontechnology when designing residences for older adults to promote aging-in-place.

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CHAPTER I

INTRODUCTION

To introduce the research topic, this first chapter begins by providing the background on aging-in-place and gerontechnology. This is followed by a discussion of research problems and aims. The research questions and the significance of this study are presented in the last sections.

Background

Gerontechnology has been studied and developed to support older adults' desire on aging in place, providing independence, autonomy, quality of life, and also reducing costs to health services (Burdick & Kwon, 2004; Lesnoff-Caravaglia, 2007). Aging-in-place is the desire to continue living a full life in the home of older adults' own choice, with a focus on quality of life and independence (Mihailidis, Cockburn, Longley, & Boger, 2008).

In many countries, the proportion of the older population is increasing; this phenomenon has been a challenge for various specialty areas on a global level (Harper, 2014; Rashidi & Mihailidis, 2012). During the aging process many physical, social and psychological changes occur, influencing individuals in the use of spaces and products (Sargent-Cox, Anstey, & Luszcz, 2012).

Because of the aging process, older adults may concern with comfort, safety and own capabilities while performing daily activities. Such activities encompass eating, using the toilet, dressing, performing activities of transference, bathing, and walking. The inability to complete such tasks or activities may result not only from body limitations, but also from the demands of the environment (Sargent-Cox et al., 2012; Wahl & Weisman, 2003).

One of the consequences of these changes in older adults' lives is the need to move from their own residences to a place that offers specialized care, such as continuing care retirement communities (CCRCs), assisted living facilities, or nursing homes (Weil & Smith, 2016). However, many of these facilities do not seem to be preferable environments for numerous older adults deciding where they will spend the late years of their lives (Paganini-Hill, 2013).

For an older adult to be able to remain living in their own residence, many issues need to be addressed. Among the main problems faced by older adults willing to age in place, falls are an important health issue. About 25% of people aged over 65 falls every year. Every 11 seconds, an older adult is treated in an emergency room for a fall; every 19 minutes, an older adult dies from a fall. Falls are the leading cause of fatal injury and the most common cause of nonfatal trauma-related hospital admissions among older adults. Falls, with or without injury, also carry a heavy quality of life impact. A growing number of older adults have fear of falling and, as a result, limit their activities and social engagements. This can result in further physical decline, depression, social isolation, and feelings of helplessness. (National Council on Aging, 2017).

There are different types of gerontechnological devices that act to prevent or assist in case of falls in the home environment. These devices have emerged aiming at fall prevention, fall detection, and fall monitoring (Hawley-Hague et al., 2014). Fall prevention technologies have been created or adapted to be pro-active in preventing falls, such as those which provide strength and balance training to older adults (i.e. videogames) (Miller et al., 2012; Williams et al., 2010). Fall detection technologies have been created or adapted to be active in detecting falls, bringing help to older adults after the fall has occurred (i.e. floor sensors, shoes sensors) (Brownsell & Hawley, 2004; Van Hoof et al., 2011). Fall monitoring technologies have been created or adapted with real time monitoring and are connected to a response system (i.e. video monitoring part of a whole system – home automation) (Londei et al., 2009; Mihailidis et al., 2008).

Statement of the Problem

Over recent years a number of fall-related gerontechnologies have emerged to prevent, detect, and monitor falls of older adults at home. However, the literature does not make clear who are using such gerontechnologies in the interest of aging-in-place, avoiding moving from home in order to obtain an institutionalized care. Right now, the reasons behind the use or non-use of fall-related gerontechnologies by older adults living in non-institutionalized residences are unknown.

For decades, research has been conducted to understand how innovation has been spread out among different social systems using Rogers' Diffusion of Innovations model, originally from 1962. However, little attention has been given regarding fall-related gerontechnology among older adults willing to age-in-place in their own residences. Most of the research in the area focuses on measuring the perceived characteristics of an innovation, putting aside the knowledge that older adults have or do not have about such innovation, how older adults get information about, and the relationship of older adults' residence interior design and their purchase intention of fall-related gerontechnology. In fact, with regards to interior design studies, very little has been discussed on gerontechnology.

Purpose of Study

The purpose of this study was to examine the diffusion of technology related to fall prevention, detection, and monitoring among older adults for aging-in-place based on the five stages of the Diffusion Innovation Theory. The predictors of the first three stages – knowledge, persuasion, and decision – were examined to understand the innovation-decision process for adoption or non-adoption of fall-related gerontechnology by older adults living in non-institutionalized residences.

Objectives of the Study

The research objectives of this investigation conducted in the state of Oklahoma, for a sample age 55 and over, included the following:

1. To investigate the first three stages of the fall prevention, fall detection, and fall monitoring gerontechnology decision processes:
    a.) Older adults' perceived knowledge on fall prevention, fall detection, and fall monitoring gerontechnologies;
    b.) Older adults' attitudes towards fall prevention, fall detection, and fall monitoring gerontechnologies;
    c.) Older adults' perceived benefits of fall prevention, fall detection, and fall monitoring gerontechnologies;
    d.) Older adults' purchase intention of fall prevention, fall detection, and fall monitoring gerontechnologies.
2. To investigate the variables that worked as prior conditions in the fall prevention, fall detection, and fall monitoring gerontechnology decision processes:
    a.) Older adults' desire for aging-in-place in their current residences;
    b.) Older adults' technology readiness;

c.) Perceived interior design of older adults' residences.

3. To investigate the variables that worked as characteristics of the decision-making unit in the fall prevention, fall detection, and fall monitoring gerontechnology decision processes:

   a.) Older adults' attitudes towards aging;

   b.) Older adults' fear of falling.

4. To investigate the communication channels in the fall prevention, fall detection, and fall monitoring gerontechnology decision processes.

Significance of the Study

Most studies that have addressed gerontechnology in relation to aging-in-place have concentrated on the characteristics of the innovation but not on its diffusion (Chen & Chan, 2014a; Chen & Chan, 2014b; Kim et al., 2009; Ma et al., 2016; Peek et al., 2014). There have not been many empirical studies about the relationship between older adults aging-in-place and their decision process towards fall-related gerontechnology. In addition, there are minimal studies that have investigated the importance of the interior design of older adults' residences as a prior condition for an individual's attitudes towards fall-related gerontechnology. Therefore, the results from this study are expected to provide interior designers, marketers, product designers, and policy makers with valuable information concerning the conceptualization, development, distribution, and marketing of new fall-related gerontechnologies that will support aging-in-place in the future.

Many studies on diffusion of innovation indicate that socio-economic characteristics such as age, education, and income are strongly connected to innovation decision (Pang et al., 2016; Rogers, 2003; Zanello et al., 2016; Zhang et al., 2015). Even though differences on these characteristics distinguish users on earlier adopters or latter adopters, research has not found consistent evidence about age and innovativeness. Some studies have indicated that when all baby boomer generation (born between

1946-1964) grow older, there will be more adoption of innovation from older adults (Kuerbis et al., 2017; Löfqvist et al., 2016; Mihailidis et al., 2008; Sox et al., 2016).

For this study, some constructs were modified from the original model in order to fit older adults' characteristics, desire for aging-in-place, and challenges on technology use. The knowledge stage, considered as perceived knowledge, is influenced by characteristics of older adults such as aging attitudes and fear of falling. The persuasion stage includes attitudes towards gerontechnology and attitudes towards benefits of gerontechnology, while the decision stage deals with purchase intention. In addition, desire to age-in-place, technology readiness, and interior design aesthetics appeal are added as prior conditions which influence the both knowledge and persuasion stages in the innovation-decision process. All of the three stages are influenced by the communication channels, which are the sources and/or people who inform older adults and impact them towards gerontechnology acceptance. These modifications in the original model will bring a new perspective to research on fall prevention, fall detection, and fall monitoring gerontechnology adoption, helping researchers, designers, and policy makers to understand the process of gerontechnology acceptance

CHAPTER II

LITERATURE REVIEW

In this section, concepts like aging-in-place, falls and injuries in the home environment, gerontechnology, and fall-related gerontechnology are discussed. In the end of this section the theoretical framework and the hypotheses are presented. When older adults have the possibility of aging-in-place, their autonomy is preserved and it impacts positively their psychological health (Paganini-Hill, 2013; Rioux, 2005). As an interior design component, gerontechnology acts in terms of environmental safety for older adults willing to age-in-place (Mahmood et al, 2008; Mihailidis et al., 2008).

Aging-in-Place

What is Aging-in-Place?

Aging-in-place is often considered the desire of a person to remain living in their own residence and not having to move to a Continuing Care Retirement Community (CCRC), an assisted living facility or a nursing home (Mihailidis et al., 2008; Hwang, Cummings, Sixsmith, & Sixsmith, 2011).

However, Lawton (1990) describes aging in place as a transition in life that causes modifications in both people and home environment over time. The personal changes in people happen psychologically, physically and socially. With regards to the home environment in the process of aging-in-place, the residents may make some alterations to their housing in order to create a more comfortable, safe and private atmosphere (Lawton, 1990).

Environmental Factors for Aging-in-Place

There are external and internal factors interrelated to aging-in-place. The external factors are associated with the person's ability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs) (Eriksen et al., 2015; Pierce, 2012; Rowles et al., 2004). ADLs are defined as daily activities related to personal care, such as bathing, dressing, toileting, transferring bed/chair, eating, etc. IADLs are defined as daily activities related to independent living, such as cooking, doing housework, doing laundry, etc. Some of the external environmental characteristics necessary to perform both ADLs and IADLs are environmental accessibility, environmental usability, and environmental safety. The external aspects must be observed and experienced in the residence in order to allow older adults to age-in-place (Güttler et al., 2015; Piece, 2012; Rowles et al., 2004). On the other hand, the internal factors are described as cognitive attributes that a person observes and experience in a place. With regards to the home environment, some of these attributes are sense of belonging, sense of control, sense of comfort, familiarity, and aesthetics (Bakola et al., 2014; Fernández-Ballesteros, 2001; Güttler et al., 2015; Rowles et al., 2004).

For many years, scholars on Environmental Gerontology have been studying the relationship between environmental characteristics and older adults' capacities to perform ADLs and IADLs (Altman et al., 1984; Lawton, 1983; Wahl et al., 2009; Wahl & Weisman, 2003; Werngren-Elgström et al., 2009). Lawton (1983), based on Lewin's Field Theory and on Murray's Theory of Environmental Press, developed the Competence-Environmental Press Model. The aim of this model is to predict a person's behavior towards the environment based on the relationship between the pressure that a person suffers from the environment, and their cognitive and physical competencies (Altman et al., 1984; Lawton, 1983; Wahl et al., 2009; Wahl & Weisman, 2003; Werngren-Elgström et al., 2009).

As outcomes, negative behavior is predicted "when the environmental demands are too strong for the subject's competence level" (Fernández-Ballesteros, 2001, p. 41). In this situation, the environment is a stressor and the person has difficulties to perform ADLs and/or IADLs independently, needing help for most activities (Altman et al., 1984; Fernández-Ballesteros, 2001). In many cases, people facing such challenges tend to move to a health care facility, such as an Assisted Living or a Nursing Home (Eriksen et al., 2015; Werngren-Elgström et al.,2008). Negative behavior can also occur if "the environmental demands are too weak and the competence level very high" (Fernández-Ballesteros, 2001, p. 41). This situation causes reduction on competencies by not practicing (Altman et al., 1984; Lawton, 1983; Fernández-Ballesteros, 2001). The ideal situation is "when the environment combines the highest degree of pressure stimulating the subject's highest level of competence" (Fernández-Ballesteros, 2001, p. 41). This is ideal because a person's both cognitive and physical systems are continually stimulated by the environment. Older adults, looking for products or services in order to help them to reduce environmental pressure, may at this point get some knowledge on gerontechnology that will serve as a base for building preferences for the use or non-use of technology at home (Kohlbacher and Hang, 2011).

Barriers for Aging-in-Place

Successful aging-in-place for older adults rely on the maintenance of independent living, autonomy over decisions in life, and the development of a series of feelings that attach emotionally a person to their home (Evans et al., 2002; Oswald et al., 2010). Unfortunately, a sequence of factors combined could cause older adults to leave their homes, moving to a health care facility (Peace et al., 2011). Year after year, long-term care facilities receive many older adults that have lost their autonomy and independence and this number has been increasing over the years (Centers for Medicare and Medicaid Services, 2015).

One of the reasons for independence loss relies on housing safety issues (Ahrentzen & Tural, 2015). With regards to interior design, environmental hazards are common at older adults' residences. People have the tendency of not modifying the interior design environment as part of a plan for aging-in-place (Rioux & Werner, 2011). Because of that, sooner or later older adults realize that simple activities as bathing, cooking, or using the toilet have become hazardous (Oswald et al., 2010; Rioux & Werner, 2011).

Older adults also lose their independence at home when not able to perform some activities due to restricted body movements (Ahrentzen & Tural., 2015; Rowles et al., 2004). Not being able to reach objects on top shelves or inside low cabinets, and the use of staircase may be responsible for older adults moving from home (Fernández-Ballesteros, 2001; Rioux & Werner, 2011).

Falls and Injuries in the Home Environment

Although it is common to fall during all stages of life, falls may represent a more serious health problem with a higher risk of injury among older adults (Faul et al., 2016; Kenny et al., 2016; Tideiksaar, 2003). Besides physical injuries, falling also carries out a psychological impact, causing fear of falling repeatedly and depression (Holloway et al., 2016).

Two conditions must be present for a fall to occur: loss of balance and failure of postural control to compensate the lack of balance (Faul et al., 2016). These conditions may have external causes such as a collision to an object, slips, or tripping, or internal causes such as ischemic attacks and cardiac arrhythmias (Wildes et al., 2015). External causes are usually result of environment conditions (Cleary & Skornyakov, 2017; Ritchey et al., 2015). Internal causes are related to a person's body and mind. The aging process changes people's bodies and minds, and the environment must be prepared for such changes (Marrero et al., 2017; Nascimento et al., 2017). Disturbs on visual functions, body balance, walking, muscles, and bones are internal causes. In addition, cognitive disorders such as anxiety, depression, dementia, and frailty denial – which occurs when an older adult does not accept the changes that happen with them in the aging process – are also considered internal causes (Marrero et al., 2017; Nascimento et al., 2017).

Some external factors that play an important role in the occurrence of falls are stairs, floor surfaces, furniture design, bathroom fixtures, and lighting conditions (Ahrentzen & Tural, 2015; Tideiksaar, 2003). Most falls that happen in the home environment take place in the bedroom and bathroom. It does not mean necessarily that these spaces are unsafe, but instead, it means that older adults may be less cautious in familiar surroundings (Marrero et al., 2017; Nascimento et al., 2017; Tideiksaar, 2003;). Another explanation could be that older adults at greater risk for falls may spend more time in their bedroom and bathroom than in other places of the house (Tideiksaar, 2003; Wildes at al., 2015). Therefore, falls at home may represent an exposure to environmental problems that need to be addressed (Marrero et al., 2017; Oswald et al., 2010). Interior design and product design that respect the changes in life are essential to provide independence, autonomy, and quality of life for older adults aging-in-place.

Home Modifications

The concept of home modification is not new. According to Lindsley (1964), the continuous action of designing and improving spaces could, without affecting physical limitations, empower an individual to cope with the environment more effectively. Studies on occupational therapy have opted for home modifications as a way to respond to the needs of frail older adults or disabled people (Karlsson, Vonschewelov, Karlsson, Cöster, & Rosengen, 2013; Stevens, Holman, Bennet, & Klerk, 2001). Historically, studies on the use of technology at the home environment for aging-in-place proposed home modifications for older adults. Such studies consider floor materials, grab-bars, illumination, furniture, windows, and door handles as technological products (Pinto et al., 2000; Pinto, Medici, Zlotnick, Bianchi, Sant, & Napoli, 1997).

Home modifications are adaptations to living environments intended to increase ease of use, safety, security, and independence (Karlsson et al., 2013; Stevens et al., 2001). Modifications include: (1) change or additions to the structure (e.g. widening doorways, adding a first floor bathroom or a ramp); (2) special equipment (e.g. grab bars and handrails); (3) changing the location of items (moving furniture); and (4) adjusting the way where activities are carried out (moving to a first floor, changing the use of room). Home modifications overlap considerably with assistive devices (e.g. bath benches), which tend to be more mobile in nature and not attached to the structure of a house (Karlsson et al., 2013; Pinto et al., 2000; Pinto et al., 1997; Stevens et al., 2001).

Home modifications and repairs have been emerging issues related to aging-in-place. Many older adults report their home modifications or repairs as one of the ways to get a safer place and live with more independence and convenience (Karlsson et al., 2013). Some studies suggest that aging-in-place strategies such as home modifications require a wide array of human, financial, and home maintenance services to enable older adults to meet their needs (Pinto et al., 2000; Pinto et al., 1997).

Gerontechnology

According to Lesnoff-Caravaglia (2007), gerontechnology is a combination of gerontology and technology and involves the research and the development of techniques, technological products, services, and environments based on knowledge of aging process. Gerontechnology aims to provide the autonomy for older adults, so they can lead their lives healthier, independently, and socially engaging on a continual basis (Lesnoff-Caravaglia, 2007).

Traditionally, the interaction between gerontechnology and users has been studied through ergonomics and universal design (Pinto et al., 2000; Pinto et al., 1997; Riva & Gamberini, 2000). Researchers would consider low-technological products (i.e. furniture) as gerontechnology and would investigate its relationship with older adults (Pinto et al., 2000; Pinto et al., 1997). Also, car ergonomics and safety devices for older adults drivers were also investigated for more than two decades (Sixmith & Sixmith, 1993). In addition, assistive technology has been studied to aid older adults to perform activities after having a disability (Bühler, 1996). As part of high technology, the development of virtual environments has been studied for the development of telemedicine (Riva & Gamberini, 2000). Telemedicine uses information technology and telecommunications for patient health care from a distance (Riva & Gamberini, 2000).

More recently, gerontechnology has been considered as some type of high-technology device, and research on gerontechnology has been investigating what leads older adults to adopt or to reject innovation. Studies using Technology Acceptance Model (TAM), have identified that perceived usefulness, perceived ease of use, technology anxiety, perceived adaptiveness, social influence, trust, and privacy concerns influence older adults' attitudes towards gerontechnology. Perceived usefulness is "the degree to which a person believes that using the particular technology would improve his/her quality of life" (Chen & Chan, 2014b, p. 130). Perceived ease of use is "the extent to which a person believes that using a technology would be free of effort" (Chen & Chan, 2014b, p. 130). Technology anxiety is when a person feels anxious or emotional reactions when it comes to use the system (Chen & Chan, 2014a; Chen & Chan, 2014b; Heerink et al., 2010). Perceived adaptiveness is "the perceived ability of the system to adapt to the needs of the user" (Heerink et al., 2010, p. 364). Social influence is "the person's perception that people who are important to them think they should or should not use the system" (Heerink et al., 2010, p. 364). Trust is the belief that the system performs with integrity and it is reliable (Heerink et al., 2010). Finally, privacy concern is the extent to which a person believes that using a technology would affect their privacy (Lorenz-Huber et al., 2011; Mihailidis et al., 2008). All these factors influence positively or negatively for an older adult to adopt a technology.

Gerontechnology for Independent Living

Based on existing research, residential technology is defined as a system of components in the house that enhances and promotes convenience, safety, security, communication, and comfort (Kim et al, 2009; Peek et al., 2014). Residential technology can be divided into four categories according to the technology's main usage: 1. housing and daily living technology (i.e. electric cooking products, remote control devices); 2. communication technology (i.e. mobile phones, computers, internet); 3. health technology (i.e. health products or sports equipment, emergency alert products/services, telecare); and 4. education and recreation technology (i.e. electronic dictionary, digital camera, CD/MP3/MP4, DVD player) (Chen & Chan, 2014; Ma, Chen, & Chan, 2016).

Residential technology can also be put into the categories of high technology, middle technology or low technology, according to the technology's degrees of functions and the current adoption rate (Hansen & Serin, 1997; Hatzichronoglou, 1997; Kumar & Siddharthan, 1994). High technology uses physical and chemical principles to report and define information on older adults' state of health. Middle technology uses advanced principles in every-day equipment around the home, like television and stereo. Low technology includes devices such as furniture, bathroom appliances, heating utensils, and clothing (Hansen & Serin, 1997; Hatzichronoglou, 1997; Kumar & Siddharthan, 1994). Historically, much of the interest in aging revolves around the use and adoption of low technology for home modifications, to enhance safety and quality of life of older adults (Pinto et al., 2000; Pinto et al., 1997). More recently, much effort has been invested in the development of technology to support older adults to live independently and to promote aging-in-place, such as sensor-based networks for activity monitoring, fall and wandering detection, and diverse e-health application (Burdick & Kwon, 2004; Cini, 2016; Lesnoff-Caravaglia, 2007; Ma et al., 2016).

According to Cini (2016), there are many different types of technology that will be changing the face of senior living in very few years. Some of the technology that she talks about already exist for other purposes (that is the case of sensors and LED lighting, for example), but designers are redefining some technologies to attend the senior population needs. Table 1 shows such technologies and which benefits could bring to older adults' lives.

Table 1

Technologies and Their Benefits for Senior Living, from Cini (2016).

Technology	**Benefits for Senior Living**								
	Independence	Dignity	Safety	Freedom of choice	Active lifestyle	Personalized care	Quality of life	Physical Fitness	Mental Fitness
Integrated Data Management System			√			√	√	√	√
Sensors	√	√	√	√	√	√	√	√	√
Wearable technology	√	√	√		√	√	√	√	√
Induction Looping Technology	√	√	√	√	√		√		√
Exoskeletons	√	√	√		√	√	√		
Robots	√	√	√	√	√	√	√		
LED lighting	√	√	√		√	√	√		

Integrated data management system consists of a group of generic technologies for managing older adults' domestic environment. It encompasses medical sensors, entertainment equipment, and home automation systems (Marsh et al., 2008). Part of integrated data management systems, sensors can be divided into wearable and non-wearable devices. They provide safety for older adults for being able to monitor their activities and call for help when needed (Godfrey, 2017; Hawley-Hague et al., 2014; Mihailidis et al., 2008).

Induction loop is "a sound system in which a loop of wire around an area in a building, such as a theater, produces an electromagnetic signal received directly by hearing aids used by the partially deaf" (Laplante-Lévesque et al., 2010, p. 144). Looping systems are compatible with all manufacturers hearing aid, they are very low cost technology, zero drain of the battery, can be used in large and small spaces, are simple to operate, brings independence and dignity to those people who need it (Cini, 2016).

Exoskeletons use engineering, computing technology and sensors to provide body movement to disable people (Cini, 2016). Most of the research in the area develops a supportive structure for walking (Pearce et al., 2012). Robots are technological devices created to help older adults doing housework, reminding them of taking meds, and on socialization, by video calling family members and friends (Beer et al., 2012; Cini, 2016).

Compared to fluorescent lights, LED lights bring a series of benefits for older adults. Fluorescent lights are not the best option for older adults because of the eyestrain caused by flickering (Cini, 2016). Also, an older adult needs about 70% more light than a 20-year-old to be able to see, and LED lights are easier to control (Cini, 2016; Maher, 2017; Tideiksaar, 2003). Among LED benefits, product designers are incorporating colorful LEDs on their heating products (i.e. stove, sink faucet) to visually show when the stove or the water coming from the sink is hot (Cini, 2016;

Maher, 2017). Flooring, handrails and door casing integrated with LED assist with wayfinding, reducing older adults trips and falls during the night (Cini, 2016).

Fall-related Gerontechnology

Over recent years, a number of technological devices have been developed to prevent falls, to detect falls, and to monitor falls of older adults (Concepción et al., 2017; Hamm et al., 2016; Hawley-Hague et al., 2014; Kosse et al., 2013; Mihailidis et al., 2008). These devices promise to help older adults to continue living at home, once they would not need a person to monitor their activities (Concepción et al., 2017; Mihailidis et al., 2008).

However, there have been issues related to older adults' adoption and continued use of these gerontechnologies (Hawley-Hague et al., 2014; Kosse et al., 2013; Mihailidis et al., 2008). Assisted living environments are usually the first adopters of fall-related gerontechnology in order to provide safety and to ensure older adults getting help as faster as possible (Cini, 2016). According to the literature, fall-related gerontechnology encompasses fall prevention, fall detection, and fall monitoring gerontechnologies (Hawley-Hague et al., 2014).

Fall prevention

Fall prevention gerontechnologies have been created or adapted to be pro-active in preventing falls, such as those that provide strength and balance training to older adults (i.e. videogames, and wearable and non-wearable sensors). Videogames have been used to provide strength and balance training to older adults in the prevention of falls (Cini, 2016; Miller et al., 2012; Williams et al., 2010). Studies in the area have been proving that playing videogames regularly reduce falls among older adults (Doyle et al., 2010; Uzor et al., 2012; Williams et al., 2010). Playing just twice a week is enough to enhance body balance when older adults need to move their bodies to reach the game goal (Williams et al., 2010).

On a different way, the multi-factorial systems used to prevent falls include sensors, risk assessment, drug review, and exercise programme (Barker et al., 2009; Cumming et al., 2008; Fonda et al., 2006). Wearable fall prevention sensors are attached to a person's thigh or foot, and they are light-weighted, have a small size, and are waterproof and shockproof (Cumming et al., 2008; Kelly et al., 2002). While the older adult is using the device, the caregiver receives an alert when they "assume weight bearing position or shift the leg from the horizontal to an angle smaller than 45 degrees" (Kosse et al., 2013, p.746). Researchers have been studying these types of fall-prevention devices in hospitals and nursing home settings, but there's no information regarding older adults living in the community (Cumming et al., 2008; Kelly et al., 2002).

In the home environment, non-wearable systems are usually placed around chair and beds. They are wireless systems that detect when an older adult gets out of a bed or rise from a chair, and detect if there is any disturb on balance, calling for help of a caregiver (Spetz et al., 2007). Smart Caregiver (2018) is a company from the United States, and among several devices has developed the Motion Sensor Pager (Figure 1). This is a device to be installed next to a person's bed that uses an infrared sensor to detect the moment when a person is getting out of bed. The system is able to call the caregivers when detecting the older adult leaving the bed (Smart Caregiver, 2018). With similar technology, it could automatically turn on the bedside lamp or other low intensity light, avoiding complete darkness when waking up in the middle of the night (Nagy et al., 2015).

Figure 1. Motion Sensor Pager from Smart Caregiver, U.S.A. (2018).

A different device, developed by Nawaz et al. (2014), was designed for fall prevention and fall management improvement (Figure 2). It consists of a touch-screen system installed in a preferred room at home. Among diverse scenarios, in terms of fall prevention it serves to encourage people to do muscle strength and balance exercises by teaching them on how to perform the exercises through video clips and animated gifs. This device is a collaboration between two universities in Norway, one is Switzerland, and one in Italy and it is in the pilot study phase (Nawaz et al., 2014).

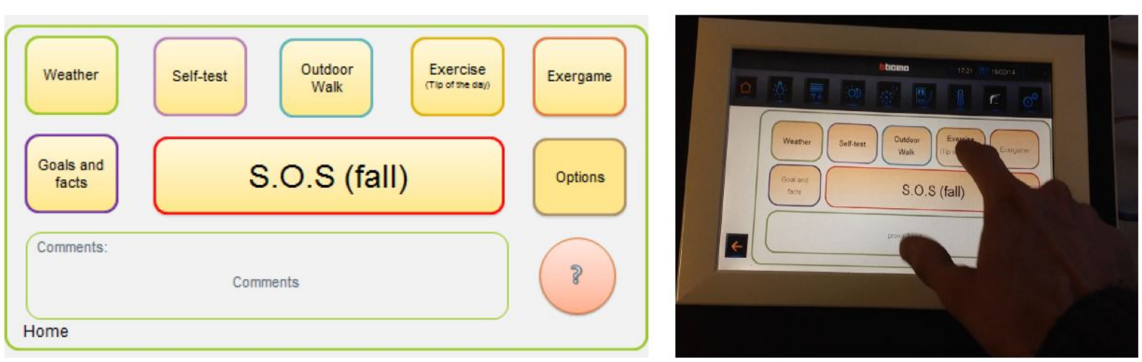

Figure 2. Smart home technology for fall prevention, by Nawaz et al. (2014). Mock-up (left) and interactive prototype (right) of the user interface on a 10-inch smart home screen.

Fall detection

Fall detection gerontechnologies have been created or adapted to be active in detecting falls, bringing help to older adults after the fall has occurred (i.e. floor sensors). This type of technology acts on reducing the time an individual lies on the floor waiting for help (Godfrey, 2017; Reeder et al., 2013). This is important because long waits are usually the cause for serious health complication among older adults (Hawley-Hague, 2014). Most of fall detection devices are divided into wearable and non-wearable sensors. The wearable sensors work similarly to the fall prevention sensors. The devices are attached to the individual and they call for help when identifying a fall (Godfrey, 2017; Reeder et al., 2013).

The non-wearable sensors have different appearances and ways of working. In smart home projects for example, fall detection sensors could be installed on the floor, underneath the carpet or tiles. This type of system is able to identify presence, direction of walking, velocity, and person lying on the floor (Cini, 2016; Marling, 2007). When the sensors identify that a person is not walking anymore, but lying down on the floor, the system calls for help. Some of the positive attributes of this system are the privacy concerns and interior design style (Cini, 2016; Marling, 2007). Research has shown that privacy is among the main concerns older adults have when they evaluate gerontechnology acceptance (Kanis et al., 2013; Mihailidis, 2008). However, floor sensors do not offer any type of privacy concern because it only detects falls (Cini, 2016; Marling, 2007). In terms of interior design style, because floor sensors are installed underneath the flooring, the interior design of the house is not affected (Cini, 2016; Marling, 2007). Figure 3 shows an example of floor sensor, developed in Germany (Sesam, n.d.). Besides calling for help when identifying a fall, this system is able to identify when a person wakes up during the night, turning on the lights when a person’s feet touches the floor (Sesam, n.d.).

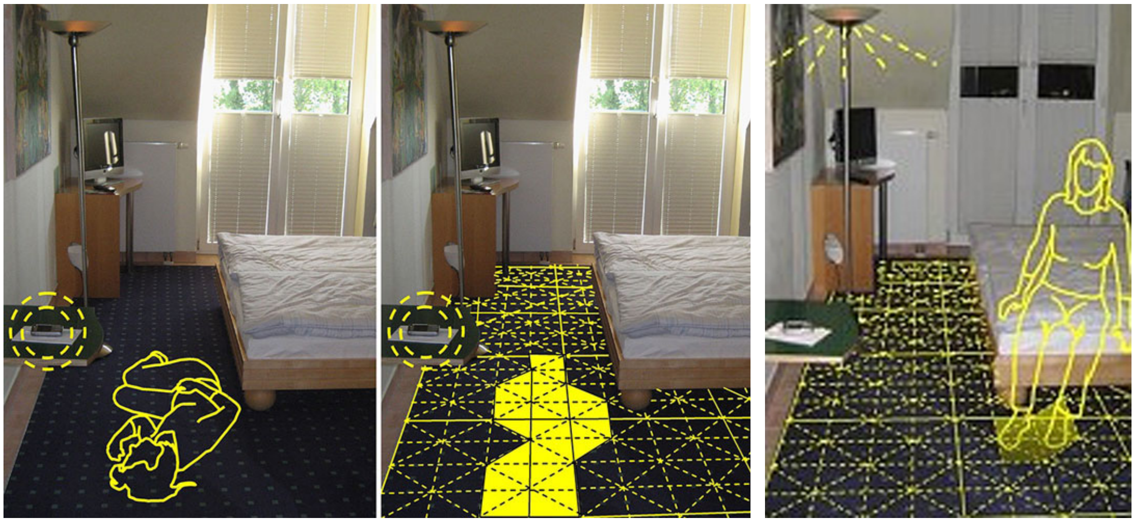

Figure 3. SensFloor by Sesam (n.d.). System calling for help after identifying a fall (left and middle) and turning on the lights during the night when a person's feet touches the floor (right).

Researchers from the Lab for Advanced Sensing, Computing & Control (ASCC) at Oklahoma State University (2017) are developing a robot that, among different capabilities, it is able to identify a fall even if the robot is not facing the person directly (Figure 4). The robot is able to talk to the person and establish a conversation to evaluate if video-calling for help is needed. If a person does not respond, it will video-call for help immediately. The model is called Companion Robot and it is at prototype stage (Oklahoma State University, 2017).

Figure 4. Companion Robot, by ASCC at Oklahoma State University (2017). Robot interface (left), and identifying a fall and video-calling for help (images on the right).

Fall monitoring

Fall monitoring gerontechnologies have been created or adapted with real time monitoring and are connected to a response system (i.e. video monitoring part of a whole system – home automation). This type of gerontechnology includes different devices, being video cameras to monitor older adults' activities one of the most common (Hawley-Hague et al., 2014; Mihailidis et al., 2008). Standard video cameras are useful to send live images of an individual to a person who provides the service and/or to a caregiver (Chaquet et al., 2013; Srivastava et al., 2014). In a similar way, computer vision also uses video cameras to monitor older adults, but there is no human observing the images. A computer in real time analyzes older adults activities and there are no images stored (Mihailidis et al., 2008). The biggest concern about fall monitoring gerontechnology is the users' privacy. Studies on older adults' attitudes towards fall monitoring gerontechnology have identified this type of fall-related technology the least acceptable by both baby boomer cohort (born between 1946 and 1964) and silent generation cohort (born between 1925 and 1945) because of the presence of cameras around the house, especially if installed in the bathroom – one of the most hazardous room in a house (Kanis et al., 2013; Lorenz-Huber et al., 2011; Mihailidis et al., 2008; Tideiksaar, 2003).

The Alarm.com, developed in the U.S.A by BeClose (n.d.) company, is an example of Fall monitoring system and service (Figure 5). The system constitutes of a series of infrared sensors that are installed in every room of a person's house. The base unit receives signals from discreetly sensors that are located around the house, allowing family members to follow their older adult loved one's activity throughout the day, no matter how far away they are (BeClose, n.d.).

Figure 5. Alarm.com – Wellness Elderly Monitoring, by BeClose (n.d.)

Theoretical Framework

Diffusion of Innovation Theory.

In order to understand the Diffusion of Innovation theory, it is first important to establish the definition of technological innovation for this study. Technological innovation has its unique definitions in different areas of study. In this research, technological innovation is defined as "an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention" (Garcia & Calantone, 2002, p. 112). This definition shows that the process of innovation starts with the invention of a product and/or a service and goes until it is diffused among users. Usually, this is an iterative process, with introduction and reintroduction of improved technology into the marketplace (Garcia & Calantone, 2002). Although there are many technological devices available to support older adults' independence, they are only a reality for very few people (Darkins et al., 2008). The iterative process for products at the early stages of diffusion and adoption is called radical innovations, and various types of gerontechnologies could be classified as such (Garcia & Calantone, 2002). The objective of most of the innovations is to be adopted by the most number of people, as fast as possible. To be able to achieve that, the idea must satisfy the needs and expectations of the customers (Greenhalgh et al., 2004).

The theory of Diffusion of Innovations explains the process in which a new product and/or service is adopted or rejected by their intended users (Rogers, 2003). This theory says that in every community, there are five different types of people or groups' profiles. These groups are classified by how long they take to accept and begin using an innovation. To every innovation, the innovation-decision starts with very few people, called the innovators, or technology enthusiasts. These individuals represent 2.5% of the population; they are the first group to discover and begin use of the innovation without any previous knowledge of the product or service. These people are characterized by being risk-takers, and are open to test the product as soon as they become knowledgeable of it. The next group to adopt the innovation is called early adopters, or opinion leader, and they represent 13.5% of the population. They are trendsetters because they are quick to adopt innovation approved by their innovators friends. This group is very important to the process of diffusion of innovation because their innovation approval is decisive to overcome the chasm (Figure 6). The chasm is an expression used to determine the stage where the innovation adoption is able to fill the gap between the opinion leaders and all the rest of the population (Liu, 2012; Rogers, 2003; Zhang, 2015).

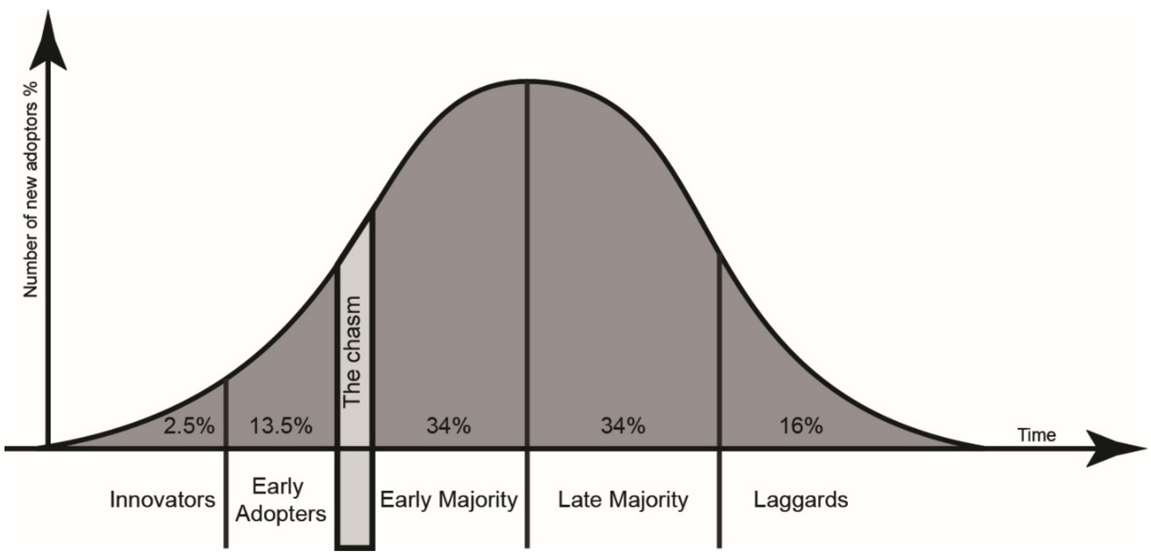

Figure 6. Adoption of innovations over time, from Rogers (2003).

The next group is called early majority, or pragmatists, and represents 34% of the population. As soon as they realize that people that they know and trust, usually the opinion leaders, have adopted a certain product/service they also adopt the innovation. At this point, the acceleration in adoption rate increases. However, to achieve all of the community, the innovation must reach a critical group, the late majority, or the conservatives. This group also represents 34% of total population. When reaching this group, the innovation is so disseminated that it continues spreading to the rest of the population by itself, becoming a new well-accepted social norm. Finally, when most of people already adopted the innovation, the new product/service reaches the laggards, or the skeptics. Representing 16% of the population, this group of people are very resistant to changes, and in some cases, they never really adopt the innovation (Liu, 2012; Rogers, 2003; Zhang, 2015).

The time for all this process to happen depends on the innovation characteristics and the community characteristics. However, the innovation adoption rhythm is always the same; it starts slowly, speeds up, and recedes.

With regards to this study, the examination of fall prevention, fall detection, and fall monitoring gerontechnology adoption will help us to understand the process of gerontechnology acceptance. Gerontechnology is at the early stages of diffusion (Chen & Chan, 2014; Mertens et al., 2015; Bouwhuis, 2017), and according to Rogers (2003), this is the best time to identify the early adopters and to examine the predictors for an innovation's adoption. Therefore, this study will investigate fall-related gerontechnology diffusion by examining the predictors of knowledge, persuasion, and decision stages in the innovation-decision model.

Five Stages of the Innovation-Decision Process.

During the innovation-decision process, the decision-maker experiences three stages until they reach a decision to adopt an innovation, and then undergo two additional stages in order to confirm or reject it (Rogers, 2003). Overall, this process encompasses actions and choices that lead the individual or organization to evaluate the innovation and reduce the uncertainty before adopting something new (Rogers, 2003). The five stages of the innovation-decision process are shown in Figure 7.

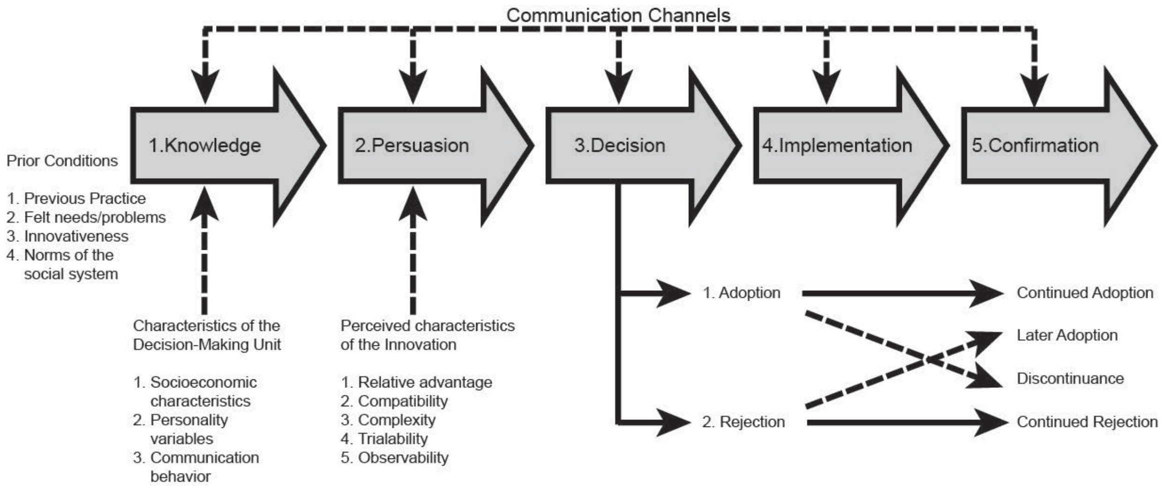

Figure 7. Model of stages in the innovation-decision process, from Rogers (2003).

According to the model, knowledge is the first stage of the innovation-decision process. This is when the decision-maker is first exposed to the innovation's existence and some of its functions. Previous practice with similar products, a problem identified or the feeling of need for some product with such functionalities, the innovativeness of the product, and the social norms in the system are the prior conditions for the first stage. For example, a person who already uses Internet on daily basis and does not have much time to go to a supermarket living in a big city, starts using the Internet to buy groceries that will be delivered in her front door in the time previously scheduled. Their previous practice using Internet, their problem of limited time, the innovativeness of being able to receive the groceries in a convenient time, and the fact that they live in a society where Internet shopping is common and good services are provided encouraged the customer to start the innovation-decision process. In addition, the characteristics of the decision-maker such as socioeconomic characteristics, personality, and communication behavior direct effects on an individual's knowledge of an innovation (Liu, 2012; Rogers, 2003; Zhang, 2015).

The second stage is called persuasion. Persuasion is the point at which the perspective adopter is open to the idea of acceptance. At this point, the decision-maker is actively seeking information, which will substantiate their future decision. Five innovation characteristics were identified to explain why some products are widely adopted and others are not: the decision-maker needs to be able to observe clearly good results from the innovation; also, they need to see the advantage on using the product and/or service; the innovation needs to be compatible with an individual socio-cultural values, perceived needs, and previous ideas; being able to try and experience the innovation before making a decision also helps on its adoption; and finally, the more complex the product, the less it will be adopted (Liu, 2012; Rogers, 2003; Zhang, 2015). In other words, products that are useful, simple to manage, and are available for trying before purchasing will have higher adoption rates.

The third stage is the decision stage. After gathering enough information, the decision-maker will decide on adopting or rejecting the innovation. Predictors of the first two stages might direct or indirectly influence on the decision-making (Liu, 2012; Rogers, 2003; Zhang, 2015).

The last two stages, implementation and confirmation, are when the individual or company implements the innovation and confirm its continued adoption or decides for its discontinuance (Rogers, 2003). Among all of the stages, there are communication channels, which are the channels from where the decision-maker gets information on the innovation. The channels can vary from family members, friends, Internet, TV, radio, etc. (Rogers, 2003; Zhang, 2015).

At this point, few studies have investigated the diffusion of innovations among older adults. Most studies concerning gerontechnology investigate products' usefulness, usability, and other attributes but they do not consider the adoption of those products by their target population for aging-in-place (Chen & Chan, 2014b; Heerink et al., 2010; Mihailidis, 2008). Also, there are minimal studies that have investigated the importance of the interior design of their residence for diffusion of gerontechnology.

Bouwhuis (2017) warns researchers that when using the Diffusion of Innovation theory with older adults, they need to keep in mind that in most cases the older adults themselves are not responsible for making decisions about their own lives, but their caregivers or the managers of the continuous care place where they live. In this study, however, older adults will be considered the decision-maker. Thus, for the purpose of this study, participants should have autonomy on making decisions.

Hypotheses and Theoretical Model

Knowledge Stage to Persuasion Stage

According to Rogers (2003), "knowledge occurs when an individual (. . .) is exposed to an innovation's existence and gains some understanding of how it functions" (p. 169). In the five stages of innovation-decision process, knowledge leads to persuasion, or to consumers' attitudes towards the innovation. Thus, a person needs to have some understanding about an innovation before they begin to form an opinion about it. Such knowledge can be acquired from various media as well as from other individuals (Rogers, 2003).

Measuring consumers' knowledge about a product or service helps to predict consumer behavior (Chen & Deng, 2016; Flynn & Goldsmith, 1999). Previous studies indicate two main types of consumer knowledge: Factual knowledge, and perceived knowledge (Chen & Deng, 2016; Fabrigar et al., 2006; Su et al., 2014). Factual knowledge is the real knowledge a person has about a given topic while perceived knowledge is the knowledge that a person believes they have about a given topic.

In terms of the knowledge that better leads to attitudes towards a product, previous studies have shown that a person will be more persuaded towards a product if this individual receives a considerable amount of information (up to certain level) regarding the product (Chen & Deng, 2016; Fabrigar et al., 2006; Michalos et al., 2009; Su et al., 2014). However, this does not mean that this person will gain knowledge about the product by being exposed to advertisements every day; the person may solely become more familiar with it (Fabrigar et al., 2006; Michalos et al., 2009).

The question then becomes how does one better measure knowledge that will lead to persuasion? Research shows that perceived knowledge is a better predictor of how well a person understands a product (Chen & Deng, 2016; Flynn & Goldsmith, 1999; Tormala & Petty, 2007; Su et al., 2014). Questions measuring perceived knowledge adress how well informed the respondents believe they are about a given topic (Flynn & Goldsmith, 1999; Tormala & Petty, 2007).

Perceived knowledge has more impact on persuasion than factual knowledge because research has shown that attitudes towards an innovation are better predicted when they are associated with high levels of perceived knowledge. In addition, people are more motivated to purchase a product if they have higher levels of perceived knowledge rather than factual knowledge (Chen & Deng, 2016; Fabrigar et al., 2006; Michalos et al., 2009; Tormala & Petty, 2007; Su et al., 2014).

In this study, the persuasion stage encompasses attitudes towards fall-related gerontechnology and attitudes towards benefits of gerontechnology. Both variables will be further developed in the next section (persuasion stage to decision stage). Accordingly, the following is hypothesized:

H1: Perceived knowledge on fall-related gerontechnology will have a positive effect on (a) attitudes towards fall-related gerontechnology, and (b) attitudes towards benefits of gerontechnology.

Persuasion Stage to Decision Stage

According to Rogers (2003), "persuasion occurs when an individual (. . .) forms a favorable or unfavorable attitude towards innovation" (p. 169). During the persuasion stage, a person continues gathering information and building their knowledge about the innovation. However, while at the knowledge stage this information influences a person cognitively, at the persuasion stage the information have sensitive outcomes, affecting consumers' feelings (Bouwhuis, 2017; Rogers, 2003).

At the persuasion stage, a person becomes psychologically involved with the innovation, looking for information that will be translated into positive or negative messages (Rogers, 2003). During this process, a person compares such information with their reality or future reality to evaluate if the innovation fits in a person's needs and beliefs (Dearing, 2009; Greenhalgh et al., 2004). This is an attempt to reduce the uncertainties inherent to most innovations (Bouwhuis, 2017; Greenhalgh et al., 2004; Olson et al., 2011).

Research shows that at this point, family members' and friends' opinions and experiences are more convincing than other types of information sources, such as TV advertisements or Internet articles (Bouwhuis, 2017; Dearing, 2009; Greenhalgh et al., 2004; Olson et al., 2011). Thus, the outcome of the persuasion stage is a positive or negative decision towards innovation adoption (Bouwhuis, 2017; Rogers, 2003).

In this study, the persuasion stage comprises two variables: the general attitude towards fall-related gerontechnology and the attitude towards the benefits of fall-related gerontechnology (Bosmans & Baumgartner, 2005; Peek et al., 2014; Ziamou & Ratneshwar, 2003). The general attitudes towards fall-related gerontechnology is the older adults' general opinion, perceived usefulness, and perceived innovativeness about fall prevention, fall detection, and fall monitoring gerontechnologies (Ziamou & Ratneshwar, 2003). Attitudes towards the benefits of fall-related gerontechnology is the older adults' beliefs if fall prevention, fall detection, and fall monitoring gerontechnologies would be able to provide the benefits necessary to age-in-place (Bosmans & Baumgartner, 2005; Peek et al., 2014). If older adults have positive attitudes towards fall prevention, fall detection, and fall monitoring gerontechnologies, it is expected that they will be inclined to purchase the innovation (Rogers, 2003). Therefore, the following hypothesis is presented:

H2. (a) Attitudes towards fall-related gerontechnology, and (b) attitude towards benefits of fall-related gerontechnology will have a positive effect on purchase intention of fall-related gerontechnology.

Prior Conditions for Starting the Innovation-Decision Process

According to Rogers (2003), prior conditions are the circumstances that stimulate the beginning of the innovation-decision process. In this study, it is considered prior conditions the older adults' desire to age-in-place at home, their propensity to embrace and use new technologies, and the self-reported evaluation on the interior design aesthetics of their houses (Arnold & Reynolds, 2003; Krout et al., 2002; Parasuraman & Colby, 2015; Rowless et al, 2004). In the five stages of the innovation-decision process from Rogers (2003), the prior conditions appear before the knowledge stage, indicating that these conditions come before any knowledge on the innovation. However, other scholars have argued that individuals will not learn about an innovative product or service unless they initially see its advantage based on some prior conditions (Dobbins et al., 2002; Friestad & Wright, 1994; Leonard-Barton & Deschamps, 1988).

Aging-in-place refers to being able to live for as long as possible in the residence of older adults' own choice, and not in a long term care facility (Paganini-Hill, 2013; Wiles et al., 2011). In addition, it means that older adults are able to maintain their independence and autonomy in their home environment. In order to make this happen, older adults should interact with a home environment that fulfill their needs over time, as these needs may change (Paganini-Hill, 2013; Pierce, 2012).

In this study, desire of aging-in-place is investigated to understand its influence on perceived knowledge about fall-related gerontechnology and attitudes towards benefits of fall-related gerontechnology (possibility of aging-in-place) (Rogers, 2003). Previous studies emphasized that desire to age-in-place and perceived benefits of technology increase technology acceptance (Lorenzen-Huber et al., 2011; Mahmood et al., 2008; Mihailidis et al., 2008; Steele et al., 2009; Van Hoof et al., 2011). Accordingly, the following hypothesis was developed:

H3. The desire to age-in-place in their current home will have a positive effect on an individual's (a) perceived knowledge about, and (b) attitudes towards benefits of fall-related gerontechnology.

Technology readiness is defined as "people's propensity to embrace and use new technologies for accomplishing goals in home, life, and at work" (Parasuraman, 2000, p. 308). Researchers on different areas such as mobile commerce, social media, and cloud computing have been largely studying their target users' technology readiness before launching a new system or product (Borrero et al., 2014; Ferreira et al., 2014; Kuo et al., 2013; Purani & Sahadev, 2015). In his original model, Rogers (2003) says that the degree of innovativeness of the decision-making unit affects the beginning of the innovation-decision process. Also, the higher the degree of innovativeness, the faster the decision-making unit adopts a cutting edge technology (Parasuraman & Colby, 2015; Rogers, 2003). Technology readiness help researchers to classify their target users as explorers, pioneers, skeptics, paranoids, and laggards (Parasuraman & Colby, 2015). The diffusion of innovation theory divides the population into a similar classification when explaining that the time taken for an innovation to spread out depends on the users' characteristics (Rogers, 2003). Accordingly, the following is hypothesized:

H4. Technology readiness will have a positive effect on an individual's (a) perceived knowledge and (b) attitudes towards fall-related gerontechnology.

In this study, interior design aesthetics refers to an appreciation of the physical design or appearance of older adults' housing habitat, and is based on the premise that people notice and enjoy the physical elements of different environment, including their homes (Ahola & Mugge, 2017; Arnold & Reynolds, 2003; Bloch et al., 1994; Giese et al., 2014; Rowless et al., 2004). Research has shown the importance of the home atmosphere in influencing a wide variety of emotions and behaviors related to housing satisfaction (Rowless et al, 2004; Mercer, 2014; Turskis & Joudagalviené, 2016). Developers of new technologies for home environment have been spending time and efforts to improve the aesthetics of the devices to become more appealing to the users. Some authors argue that in the same way that a website's design can increase a consumer's confidence, much like a good housing interior design can promote confidence in the use of home technology devices. In doing so, the technology can increase a person's trust in the house (Van der Heijden et al., 2003). If older adults consider the interior design as appealing, we should expect that it would likely be positively correlated with attitudes towards and purchase intention towards fall-related gerontechnology for aging-in-place purposes. Therefore:

H5: Interior design aesthetics appeal of older adults' home environment will have a positive effect on an individual's (a) attitude towards, and (b) purchase intention of fall-related gerontechnology.

Communication Channels to Knowledge, Persuasion, and Decision Stages

According to Rogers (2003), a channel "is the means by which a message gets from the source to the receiver" (p. 204). For the purpose of this study, communication channels are divided in two sources of information: interpersonal channels and mass media channels. Research says the communication channels influence people's knowledge, persuasion and decision towards innovation in different ways (Beck et al., 2014; Chang et al., 2015; Chirumalla, 2013; Rogers, 2003).

Interpersonal channels come from an individual's relationships with family members, friends, and co-workers. Usually, this channel is responsible for a person's initial knowledge about an innovative product or service and will have a greater impact on a person's persuasion and decision towards the innovation. When a person sees a trustworthy individual using an innovation, this person becomes more likely to do the same (Pang et al., 2016; Rogers, 2003; Zhang et al., 2015).

Rogers (2003) made such generalization about interpersonal versus mass media channels: "mass media channels are relatively more important at the knowledge stage, and interpersonal channels are relatively more important at the persuasion stage in the innovation-decision process" (p. 205). Mass media includes television, radio, newspapers, magazines, Internet websites, etc. Because mass media can reach a large number of people even when people are not actively seeking specific information, they do well on spreading knowledge about an innovation and making the innovation become more familiar to the target audience (Chirumalla, 2013; Laonardi, 2014). Also, people with more exposure to mass media channels get to know about an innovation earlier than people in the opposite situation (Beck et al., 2014; Rogers, 2003).

A lot has been discussed about communication channels influence on knowledge, persuasion, and decision in the literature. Some researchers suggest that because a person cannot look for information about an innovation unless first knowing about its existence, the first knowledge about innovation is obtained by chance (Beck et al., 2014; Chirumalla, 2013; Leonardi, 2015). In this case, people are usually more exposed to messages that are in accordance to their personality, needs, and interests (Kim et al., 2015; Chong et al., 2014). These researchers defend that the main role of mass media is to spread innovation (Beck et al., 2014; Chirumalla, 2013; Leonardi, 2015).

On the other hand, some other authors argue that mass media has great influence on persuasion, and not just on knowledge (Chang et al., 2015; Crook et al., 2016; Diehl et al., 2016; Hudson & Thal, 2013). They state that mass media contains persuasive messages that act directly on a person's perceived knowledge, and perceived knowledge has higher influence on a person's attitudes towards an innovation than factual knowledge (Chang et al., 2015; Chen & Deng, 2016; Crook et al., 2016; Diehl et al., 2016; Hudson & Thal, 2013; Tormala & Petty, 2007; Su et al., 2014).

Based collectively on this information, the following hypothesis is proposed:

H6. Sources of information will be correlated to an individual's (a) perceived knowledge, (b) attitudes towards, and (c) purchase intention towards fall-related gerontechnology.

Characteristics of the Decision-Making Unit to Knowledge Stage

Rogers (2003) made some generalizations that explain how characteristics of the decision maker – in this study, the older adults – would influence knowledge about an innovation. He states that people with a higher educational level, higher social status, more exposure to interpersonal channels, more sociable, more cosmopolite will get to know about innovation earlier than people in the opposite situation. Although an individual may obtain information about an innovation first than others, it does not mean that this person will adopt it first (Zhang et al., 2015). An individual may see the innovation as not relevant for them or they may be insecure about adopting the innovation (Lian & Yen, 2014; Zhang et al., 2015).

In this study, the older adults' characteristics that will be investigated are: aging attitudes and fear of falling (Yardley et al., 2005; Shenkin et al., 2014; Tideiksaar, 2003). With regards to older adults, their aging attitudes are relevant in order to understand how they face the changes and challenges inherent to the aging process and how it influences their knowledge about fall-related gerontechnology (Pang et al., 2016; Shenkin et al., 2014; Zhang et al., 2015). Rogers (2003) said that people who deal better with changes in life have better attitudes towards innovation. On the other hand, if older adults do not feel experiencing much of a change in their aging process, that could cause indifference towards innovation.

In this study, aging attitudes is considered the attitudes that an older adult has towards the changes that happen in their life during the aging process. Accordingly, the following is hypothesized:

H7: A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall-related gerontechnology.

Fear of falling often occurs after an individual has had a fall episode, especially if the recovering time was long and difficult (Patel et al., 2014; Tideiksaar, 2003). The effects of fear of falling are usually very damaging and hard to overcome. Fear of falling in older adults may be responsible for restriction of mobility and activities, particularly those that happen outside home (Denkinger et al., 2015; Patel et al., 2014; Tideiksaar, 2003). When older adults confine themselves to the home environment, their body muscles tend to get weaken due to disuse, triggering the falls inside the home environment, resulting in loss of independence and depression (Denkinger et al., 2015; Tideiksaar, 2003; Young & Williams, 2015). Older adults facing fear of falling and losing independence because of it may be more inclined to learn about technological devices that can help them to overcome the problem. Rogers (2003) says that "a need is a state of dissatisfaction or frustration that occurs when an individual's desires outweigh the individual's actualities" (p.172). A need to overcome fear of falling could be responsible to start the innovation-decision process towards fall-related gerontechnology. For this reason, the following hypothesis was developed:

H8. Fear of falling will have a positive effect on the perceived knowledge on fall-related gerontechnology.

With these hypotheses, this study proposes an operational model for understanding older adults' decision process towards fall-related gerontechnology (Figure 8). To reflect older adults' characteristics, desire for aging-in-place, and challenges on the use of technology (Parasuraman & Colby, 2015; Zhang et al., 2015; Ziamou & Ratneshwar, 2003), this study modified the Model of Innovation-Decision Process, proposed by Rogers (2003). The proposed framework of fall-related gerontechnology acceptance focused on three stages – knowledge, persuasion, and decision. The knowledge stage, considered as perceived knowledge, is influenced by characteristics of older adults such as aging attitudes and fear of falling. The persuasion stage includes attitudes towards gerontechnology and attitudes towards benefits of gerontechnology, while the decision stage deals with purchase intention. In addition, desire to age-in-place, technology readiness, and interior design aesthetics were added as prior conditions which influence the both knowledge and persuasion stages in the innovation-decision process. All of the three stages are influenced by the communication channels, which are the mass media sources and/or people who inform older adults and impact them towards gerontechnology acceptance.

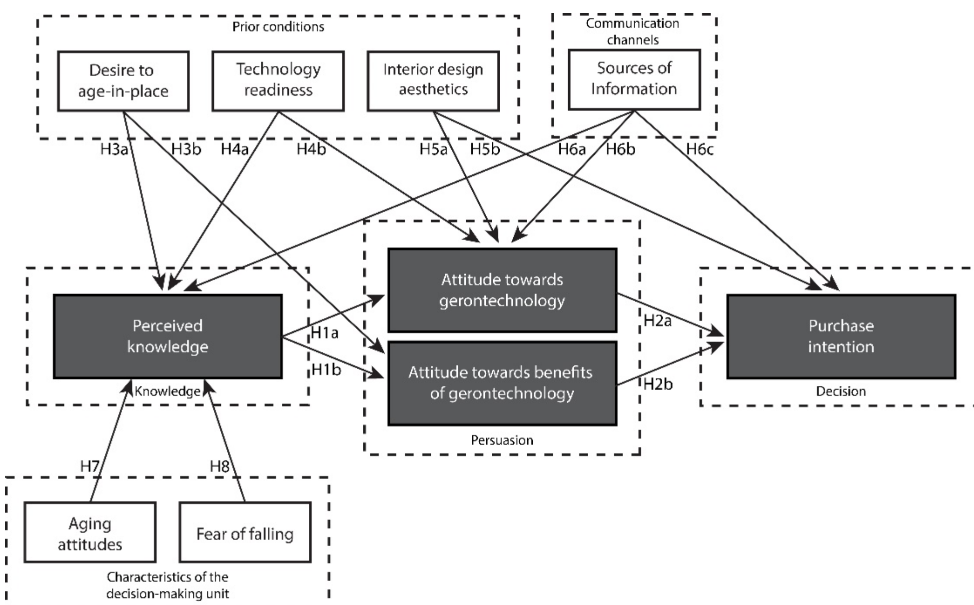

Figure 8. Operational Model for fall-related gerontechnology decision-process. This figure was modified from the model of stages in the innovation-decision process, from Rogers (2003).

CHAPTER III

METHODS

In this chapter, the research design, information on population and sample, data collection, instrument development, and data analysis for this study are discussed. In the first section, research hypothesis proposed on chapter 2 are summarized and the strategy for designing and conducting the study is specified. The second section explains the sampling method and give information about population and sample. The third section defines how data was collected. The fourth section elucidates the survey development, questions, and reliability of the questions. Finally, the last section discusses data analysis.

Research Design

The purpose of this study was to examine the diffusion of technology related to fall prevention, detection, and monitoring among older adults for aging-in-place based on the five stages of the Diffusion Innovation Theory. A modified version of the model of stages in the innovation-decision process emphasizes the desire to age-in-place, technology readiness, and interior design aesthetics of older adults' residences as prior conditions in the decision process for gerontechnology adoption (see Figure 8). The hypotheses proposed in Chapter 2 are summarized and variables are presented on Table 2.

Table 2

Hypotheses and Variables

	Hypothesis	Independent Variables	Dependent Variables
H1	Perceived knowledge on fall-related gerontechnology will have a positive effect on (a) attitudes towards fall-related gerontechnology, and (b) attitudes towards benefits of gerontechnology.	• Perceived knowledge	• Attitudes towards • Attitudes towards benefits
H2	(a) Attitudes towards fall-related gerontechnology, and (b) attitude towards benefits of fall-related gerontechnology will have a positive effect on purchase intention of fall-related gerontechnology.	• Attitudes towards • Attitude towards benefits	• Purchase intention
H3	The desire to age-in-place in their current home will have a positive effect on an individual's (a) perceived knowledge about, and (b) attitudes towards benefits of fall-related gerontechnology.	• Desire to age-in-place	• Perceived knowledge • Attitudes towards benefits
H4	Technology readiness will have a positive effect on an individual's (a) perceived knowledge and (b) attitudes towards fall-related gerontechnology.	• Technology readiness	• Perceived knowledge • Attitudes towards
H5	Interior design aesthetics appeal of older adults' home environment will have a positive effect on an individual's (a) attitude towards, and (b) purchase intention of fall-related gerontechnology.	• Interior design aesthetics appeal	• Attitude towards • Purchase intention
H6	Sources of information will be correlated to an individual's (a) perceived knowledge, (b) attitudes towards, and (c) purchase intention towards fall-related gerontechnology.	• Sources of information	• Perceived knowledge • Attitudes towards • Purchase intention
H7	A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall-related gerontechnology.	• Aging attitude	• Perceived knowledge
H8	Fear of falling will have a positive effect on the perceived knowledge on fall-related gerontechnology.	• Fear of falling	• Perceived knowledge

Hence, the research design to measure the hypotheses above was a quantitative approach, where data was collected through a cross-sectional survey. A cross-sectional survey occurs when data is collected from each participant at one point in time (Creswell, 2003). In addition, data was collected through in-person self-administered questionnaires. This approach presents positive attributes in terms of reducing the time of data collection if compared to interviews. Also, in-person questionnaires have increased response rate if compared to mail questionnaires (Neuman, 2011).

Population and Sample

The population for this study are older adults willing to age-in-place in their own house, located in the community. The inclusion criteria encompassed age (being 55 years or older), living in the community (not living in a long term care facility), and being able to read, understand, and fill out a paper survey. Population was sampled through the following organizations in Oklahoma, USA: The Aging Services Division (ASD), which is part of the Oklahoma Department of Human Services, the Oklahoma County Senior Nutrition Program, the Baptist General Convention of Oklahoma, and the local First Baptist Churches in Edmond, Oklahoma City, Sapulpa, and Stillwater.

The ASD is located in Oklahoma City and it aims “to help develop systems that support independence and help protect the quality of life for older persons as well as promotes citizen involvement in planning and delivering services” (Oklahoma Department of Human Services, Aging Services Division, 2017). The Oklahoma County Senior Nutrition Program is a program that “supports a network of nutrition sites in Oklahoma County that provide hot, nutritious meals for senior adults. The locations also offer social activities and health and wellness education” (Oklahoma City Community Foundation, 2018). The nutrition sites that participated in this study were: Candle Lake, Choctaw, Del City, La Puerta, Memorial, and Midwest City. The Baptist

General Convention of Oklahoma is a partnership of churches in the state of Oklahoma. Through them, I was put in contact to leaders of senior groups that exist in some churches around the state, and to people who were willing to gather their friends and neighbors at their own houses in order to be part of this study. The home groups that hosted this study were located in Edmond and Oklahoma City. The churches that have senior groups and were part of this study are located in Edmond, Oklahoma City, Sapulpa, and Stillwater. Figure nine shows the location of all visited groups in the state of Oklahoma.

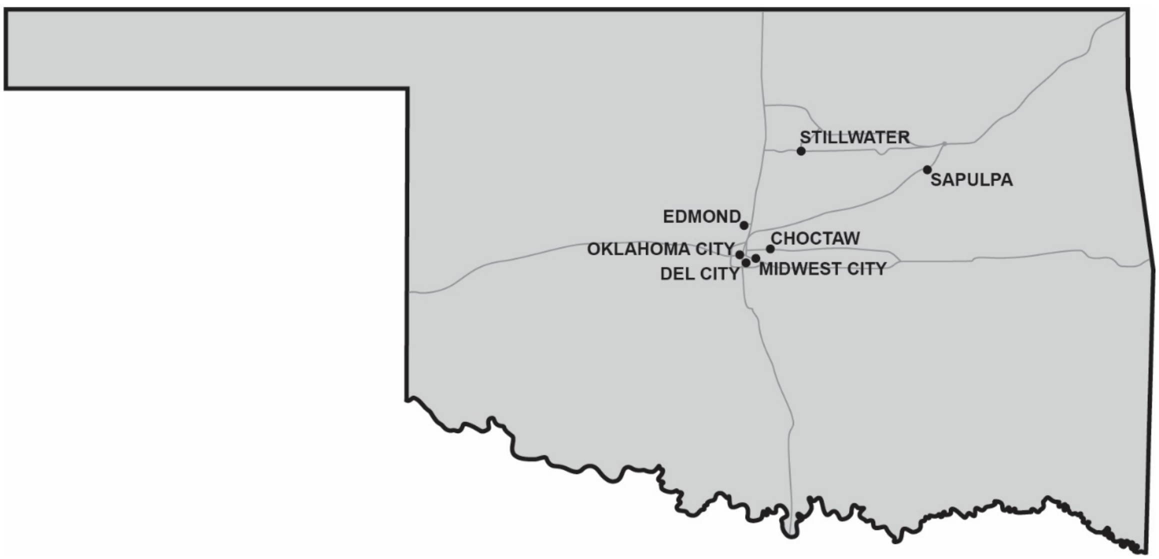

Figure 9. Location of all visited groups in Oklahoma

The first contact with the organizations was either by email or phone. With the Aging Services Division, the Oklahoma County Senior Nutrition Program, and one of the First Baptist Churches in Oklahoma City, the researcher had to schedule a previous meeting in order to present and explain the research to a committee and/or senior leaders that had to approve the study prior to visiting the groups. Through all the organizations mentioned above, the researcher was put in contact with group leaders and was able to schedule a day and time to visit the group, explain the research to the prospective participants, answer any questions and concerns that participants had, and recruit volunteers to participate in this study.

Data Collection

Before beginning data collection, the instrument was submitted to the Institutional Review Board (IRB) at Oklahoma State University for its revision regarding the protection of the rights of the study participants. After IRB approval (Appendices, p.159), the researcher conducted a pilot study to verify the contents and design of the survey. After necessary modifications, the instrument was submitted again for IRB approval and data collection was performed after that.

After conducting data collection with few groups, the researcher identified a skeptical behavior from the participants towards the consent form. Most older adults were willing to participate in the study and agreed with all information in the consent form. However, because they are seniors, they were not willing to print their names and sign the consent form. Some of them justified that their children do not allow them to sign any document. A waiver of documentation of consent – to not have a signature on the consent form was filed with the IRB for analysis. After their approval, the new version of the consent form (Appendices, p. 160) was used and data collection continued without major concerns. Font size 14 was used to help older adults with vision problems.

Data collection consisted of an in-person meeting where a self-administered questionnaire was conducted. The researcher had encounters with participants on pre-scheduled group meetings organized through the organizations mentioned in previous section. In each meeting, a group of participants were able to answer the survey at the same time. For each group, the researcher explained the research purpose, read out loud and explained the consent form. Participation in this study was voluntary. During data collection, the researcher served only to clarify questions for participants. Participants took between 15 and 40 minutes to complete the survey.

In-person surveys or interviews have higher response rates compared to internet surveys and permit more complex questions because the researcher is present to give any support participants may need (Neuman, 2011). In addition, in dealing with older adults, in-person surveys are more suitable than web surveys because the use of computers and Internet may be a barrier for participation (Quinn, 2010).

Pilot Study

The pilot study was conducted with 10 conveniently selected respondents. Respondents were faculty members and staff from Oklahoma State University, and most of them have large experience on conducting research. All respondents comply with the inclusion criteria. Respondents were asked about their experiences, such as difficulties in completing the survey, time to complete the survey, and understanding of terms used in the survey (Ahn, 2004). After, it was open for suggestions for improvement.

The survey instrument was revised based on the suggestions provided by the respondents, and consisted of adding an introductory text to the survey, modifying the order of some questions, reducing number of questions to measure a same construct, and modifying the vocabulary of some questions to make the text clearer and understandable to people that are not from this field of research.

Instrument Development

Previous literature on Diffusion of Innovation theory, interior design, aging-in-place, gerontechnology, and gerontology were utilized to obtain and create measurement items for the questionnaire (Appendices, p.162). Font size 14 was used to help older adults with vision problems. The questionnaire consisted of an introductory text followed by three sections called (1) talking about yourself, (2) talking about your home, and (3) talking about technology, respectively. Table 3 shows the measurement items and reliability of variables to be used for hypotheses testing.

Section 1 – Talking About Yourself

The first section assessed older adults' characteristics, including demographics. In this section, respondents were invited to answer personal questions about aging attitudes, health status, and demographics.

Eleven questions evaluated older adults' aging attitudes. To evaluate this construct, the attitudes to aging questionnaire was used (Shenkin et al., 2014). The original questionnaire, with 24 questions, was reduced to eleven questions because of similarity among questions and to reduce length of overall survey. In this questions, participants were asked to rate each statement using a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Some questions were reverse coded to avoid response set (Neuman, 2011).

Two questions asked about older adults' self-reported health. Both questions were multiple choice and asked about their health condition and which health problem, if any, makes difficult for them to get around their home. Finally, seven questions asked about demographic information, including three questions to evaluate participants' socioeconomic status. All of these questions were multiple choice.

Section 2 – Talking About Your Home

The second section assessed older adults' housing situation, older adults' desire and planning for aging-in-place, interior design aesthetics of their home environment, difficulties for aging-in-place in the current home, falls occurred and fear of falling in the home environment, and home modifications. All questions were multiple choice based on previous empirical research. Ahn (2004), developed her study investigating older adults' attitudes towards residential technology. Questions looking to understand older adults' housing situation, plans for future housing, and home modifications were based on her instrument, or modified from her study to be updated and to serve the purpose of this study. Among them, seven questions asked older adults about housing situation and plans for future housing, and 3 questions asked about home modification.

A total of five questions assessed older adults' desire to age-in-place (Delgado, 2008; Krout et al., 2002). A total of six questions investigated older adults' opinions on their home interior design aesthetics (Arnold & Reynolds, 2003; Bloch et al., 1994). Three questions asked about difficulties to age-in-place in the current home, and 3 questions assessed older adults falls at home. These questions were modified from previous studies (Ahn, 2004; Bos et al., 2017; Pereira, 2012). Finally, seven questions investigated older adults fear of falling (Yardley at al., 2005).

Section 3 – Talking about Technology

Lastly, the third section of the survey assessed knowledge, persuasion, and decision stages, as well as communication channels and technology readiness. All questions in this section concerning hypotheses testing were 5-point Likert-scale based on previous empirical research. Some statements were scored in reverse to avoid response set. Response set is the tendency a respondent has to develop a pattern when answering a large number of items in the same way (Neuman, 2011).

A total of 5 questions investigated the communication channels most used for older adults to learn about fall-related gerontechnology. These questions were modified from O'Cass' study (2002), giving options based on the Diffusion of Innovation Theory (Rogers, 2003).

A question presenting a list 20 high-tech products asked participants to check all of the products and services they own. A following question asked if there is any other product that was not included in the list, which the participant had purchased in order to help them to age-in-place. Seven questions investigated participants' technology readiness, assessing older adults' propensity to embrace cutting edge technologies. Through these questions, the researcher was able to categorize participants among explorers, pioneers, skeptics, paranoids, and laggards, making a relationship with the Diffusion of Innovation Theory that categorizes consumers as innovators, early adopters, early majority, late majority, and laggards (Parasuraman & Colby, 2014; Rogers, 2003).

After that, the survey presents information sheets explaining and giving examples about fall prevention, fall detection, and fall monitoring gerontechnologies (Appendices, p.178, 181, and 184). After each information sheet was presented, participants were asked to answer questions about knowledge, persuasion, and decision on each type of fall-related gerontechnology. Five questions assessed perceived knowledge. These questions were developed based on Flynn & Goldsmith's (1999) short and reliable measurement on subjective knowledge. Six questions measured attitude towards each type of fall-related gerontechnology (Bosmans & Baumgartner, 2005; Ziamou & Ratneshwar, 2003), and two questions investigated older adults' purchase and use intention of fall-related gerontechnology (Chandran & Morwitz, 2005).

Table 3.

Measurement Items and Reliability

Variable	Questions	Cronbach's alpha	Source
Section 1 – Talking About Yourself			
Aging attitudes	I feel excluded from things because of my age. [r] *strongly disagree / strongly agree* I am losing my physical independence as I get older. [r] *strongly disagree / strongly agree* Old age is a depressing time of life. [r] *strongly disagree / strongly agree* There are many pleasant things about growing older. *strongly disagree / strongly agree* Old age is a time of loneliness. [r] *strongly disagree / strongly agree* Wisdom comes with age. *strongly disagree / strongly agree* It is a privilege to grow old. *strongly disagree / strongly agree* I don't feel old. *strongly disagree / strongly agree* Growing older has been easier than I thought. *strongly disagree / strongly agree* My health is better that I expected for my age. *strongly disagree / strongly agree* Problems with my physical health do not hold me back from doing what I want to do. *strongly disagree / strongly agree*	0.78	Shenkin et al., 2014

Table 3. *(continued)*

Variable	Questions	Cronbach's alpha	Source
Section 2 – Talking About Your Home			
Desire to age-in-place	I prefer to remain living in my current residence for as long as possible. *strongly disagree / strongly agree* I prefer to seek a higher level of care (different living situation) as my needs change. *strongly disagree / strongly agree* Others' perceptions of my loss of independence would prompt me to move to a residence that could provide me with more care as I need it. *strongly disagree / strongly agree* If I were to need more assistance with daily living activities, I would rely more on my family to assist me to age in place rather than community resources. *strongly disagree / strongly agree* If I were to need more assistance with daily living activities, I would rely more on my social network to assist me to age in place rather than community resources. *strongly disagree / strongly agree*	.94	Krout et al., 2002
Interior Design aesthetic appeal	About the Interior Design of my house: *unenjoyable / enjoyable* *poor-looking / nice-looking* *displeasing / pleasing* *unattractive / attractive* *bad appearance / good appearance* *ugly / beautiful*	.90	Arnold & Reynolds, 2003; Bloch et al., 1994
Fear of falling	Cleaning the house (e.g. sweep, vacuum, dust) *not at all concerned / very concerned* Getting dressed or undressed *not at all concerned / very concerned* Preparing simple meals *not at all concerned / very concerned* Taking a bath or shower *not at all concerned / very concerned* Getting in or out of a chair *not at all concerned / very concerned*	.96	Yardley et al., 2005

Table 3. *(continued)*

Variable	Questions	Cronbach's alpha	Source
Section 2 – Talking About Your Home *(continued)*			
Fear of falling *(continued)*	Going up or down stairs *not at all concerned / very concerned* Reaching for something above your head or on the ground *not at all concerned / very concerned*	.96	Yardley et al., 2005
Section 3 – Talking About Technology			
Sources of information	To me, TV news, advertising, and current affair programs have been a valuable source of information on new technology. *strongly disagree / strongly agree* To me, newspapers have been a valuable source of information on new technology. *strongly disagree / strongly agree* To me, the Internet has been a good source of information on new technology. *strongly disagree / strongly agree* To me, radio advertising has been a good source of information during on new technology. *strongly disagree / strongly agree* To me, other people (friends, family, etc.) have been a good source of information on new technology. *strongly disagree / strongly agree*	.88	O'Cass, 2002
Technology readiness	New technology contributes to a better quality of life. *strongly disagree / strongly agree* Technology gives people more control over their daily lives. *strongly disagree / strongly agree* In general, I am among the first in my circle of friends to acquire new technology when it appears. *strongly disagree / strongly agree* I can usually figure out new high-tech products and services without help from others. *strongly disagree / strongly agree* Sometimes, I think that technology systems are not designed for use by ordinary people. [r] *strongly disagree / strongly agree* Too much technology distracts people to a point that is harmful. [r] *strongly disagree / strongly agree*	.83	Parasuraman & Colby, 2014

Table 3. *(continued)*

Variable	Questions	Cronbach's alpha	Source
Section 3 – Talking About Technology *(continued)*			
Technology readiness *(continued)*	Technology lowers the quality of relationships by reducing personal interaction. [r] *strongly disagree / strongly agree*	.83	Parasuraman & Colby, 2014
Perceived knowledge	I know very much about fall prevention/fall detection/fall monitoring technology. *strongly disagree / strongly agree* I do not feel very knowledgeable about fall prevention/fall detection/fall monitoring technology. [r] *strongly disagree / strongly agree* Among my circle of friends, I'm one of the "experts" on fall prevention/fall detection/fall monitoring technology. *strongly disagree / strongly agree* Compared to most other people, I know less about fall prevention/fall detection/fall monitoring technology. [r] *strongly disagree / strongly agree* When it comes to fall prevention/fall detection/fall monitoring technology, I really don't know a lot. [r] *strongly disagree / strongly agree*	.93	Flynn & Goldsmith, 1999.
Attitudes towards benefits of gerontechnology	Fall prevention/fall detection/fall monitoring technology can help me to remain living at home. *strongly disagree / strongly agree* Fall prevention technology can keep me from falling. / Fall detection technology is fast to call for help in case I fall. / Fall monitoring technology can keep me from falling. *strongly disagree / strongly agree* Fall prevention technology can keep me out of hospital. / Fall detection technology can help to take me to the hospital after I fall. / Fall monitoring technology can keep me out of hospital. *strongly disagree / strongly agree*	.68	Bosmans & Baumgartner, 2005
Attitudes towards gerontechnology	What is your overall opinion of fall prevention/fall detection/fall monitoring technology? *very negative / very positive* How useful is fall prevention/fall detection/fall monitoring technology? *not at all useful / very useful* How innovative is fall prevention/fall detection/fall monitoring technology? *minor variation of existing product / completely new product*	.86	Ziamou & Ratneshwar, 2003

Table 3. (continued)

Variable	Questions	Cronbach's alpha	Source
Section 3 – Talking About Technology *(continued)*			
Purchase intention	How likely are you to purchase fall prevention/fall detection/fall monitoring technology? *very unlikely / very likely* If purchased, how probable is it that you would use fall prevention/fall detection/fall monitoring? *very improbable / very probable*	.89	Chandran & Morwitz, 2005.

Note: [r] means reverse scored.

Data Analysis

A combination of descriptive statistics and inferential statistics was used to analyze the data in this study. Descriptive statistics was used to analyze the characteristics of the sample, focusing on frequencies and central tendencies of the subjects' personal characteristics. The software SPSS was used for descriptive statistics. Demographic profile of the sample, housing characteristics, aging-in-place, falls in the home environment, home modifications, and older adults' preferences in terms of home technology and gerontechnology were presented using descriptive statistics including frequencies and percentages.

Inferential statistics were used to understand the connections between independent and dependent variables in the study, measuring all hypotheses. The approach for inferential statistics used in this research was Path Analysis through Multiple Regressions. To further understand some of the connections, a series of simple linear regressions were used to explore relationships between independent and dependent variables that were not significant using multiple regression analysis. The software SPSS Process was used to assess the hypothesized conceptual model through path analysis, evaluating direct effects of all predictors, and indirect and total effects of the main stages in the model (knowledge, persuasion, and decision) when there was at least one significant direct effect in each stage.

Regression analysis is a statistical method to investigate relationships between one or more independent variables and one dependent variable (Lomax & Hans-Vaughn, 2012). Path analysis uses regressions to study direct and indirect effects of independent variables to dependent variables in a causal model formulated by the researcher (Garson, 2014; Jeon, 2015). "A direct effect is defined as the part of its effect that is not mediated, or transmitted, by other variables. An indirect effect, on the other hand, is the part of the effect of the independent variable that is mediated or transmitted by another variable. And the total effect is defined as the sum of direct and indirect effects" (Jeon, 2015, p.1638).

For this study, the operational model for fall-related gerontechnology decision-process, presented in the end of chapter 2 (see Figure 8) was built based upon the literature review. The specified model was grounded in a sound theoretical framework of the innovation-decision process, proposed by Rogers (2003). Rogers' model predicts a relationship among key constructs (knowledge, persuasion, and decision). These constructs were broken down into specific variables to be measured in this study (Table 4).

The primary objective of this dissertation was to test the hypothesized model which integrates the key constructs of the innovation-decision process. Prior conditions, communication channels, and characteristics of the decision-making unit were broken down into measurable variables and were examined in terms of their effects on stages of fall-related gerontechnology decision-process.

Table 4

Abstract Constructs from Innovation-Decision Process (Rogers, 2003) and Measurable Variables.

Abstract Constructs	Measurable Variables
• Knowledge	• Perceived knowledge
• Persuasion	• Attitudes towards gerontechnology • Attitudes towards benefits of gerontechnology
• Decision	• Purchase intention
• Prior conditions	• Desire to age-in-place • Technology readiness • Interior design aesthetic appeal
• Communication channels	• Sources of information
• Characteristics of the decision making unit	• Aging attitudes • Fear of falling

With Path Analysis, it was possible to evaluate the contribution of each independent variable to each dependent variable (Table 5). Path analysis was useful to measure each single connection between variables in the model. The aim of path analysis is to provide estimates of the magnitude and significance of hypothesized causal connections between sets of variables (Garson, 2014).

Table 5

Independent and Dependent Variables

Independent Variables	Dependent Variables
• Perceived knowledge	• Attitudes towards • Attitudes towards benefits
• Attitudes towards • Attitude towards benefits	• Purchase intention
• Desire to age-in-place	• Perceived knowledge • Attitudes towards benefits
• Technology readiness	• Perceived knowledge • Attitudes towards
• Interior design aesthetics appeal	• Attitude towards • Purchase intention
• Sources of information	• Perceived knowledge • Attitudes towards • Purchase intention
• Aging attitude	• Perceived knowledge
• Fear of falling	• Perceived knowledge

CHAPTER IV

RESULTS

This chapter presents the main results about the diffusion of gerontechnology for fall prevention, fall detection, and fall monitoring among older adults for aging-in-place. The chapter begins presenting results from descriptive statistics. Then, results from path analysis procedures are disclosed organized in three sections: fall prevention, fall detection, and fall monitoring gerontechnology. Each section closes with a summary of results from hypotheses tests.

Description of Data

Demographic Profile of the Sample

There were a total of 311 complete surveys from the 331 participants in this study. Participants who were age 55 to 64 years comprised 13% (N=43) of the total respondents. The majority of participants (N=142) were 65 to 74 years old and comprised 42.9%, followed by those who were 75 to 84 years old (N=104), comprising 31.4% of the total respondents. Finally, the last group were 85 years or older (N=42), comprising 12.7%. Among the participants, 200 were female (60.4%) and 131 were male (39.6%).

Most of the participants reported being married (N=218, 65.9%), followed by 73 participants that reported being widowed (22.1%). Divorced participants were 27 (8.2%), followed by those who were never married (N=11, 3.3%). Finally, only two participants reported being separated (0.6%).

With regards to the number of people that were 55 years or older living in the same household, 105 (31.7%) reported being the only person in the household who was 55 years or older; 213 (64.4%) answered that two people were 55 years or older; and 12 (3.6%) said that more than two people were 55 years or older.

Concerning the education status, the majority of participants (N=77, 23.3%) had some college education, but not a degree. Next, 67 (20.2%) participants reported having Bachelor's degree. The number of participants that got a Master's degree (N=55, 16.6%) was similar to those who had just completed the high school and have never pursued a college degree (N=54, 16.3%). After, there were those participants that completed a technical training (N=27, 8.2%) and those who had an associate degree (N=24, 7.3%). Participants who completed their Ph.D. were 16 in total (4.8%). At the bottom of this list were those with some high school (N=4, 1.2%) and those with a professional degree (N=3, 0.9%). To summarize, 186 (56.9%) participants have not finished college and 141 (43.12%) have finished college.

The annual income follows a progression that the majority of the participants reported getting less than \$50,000/year (N=126, 38.1%) and a really small portion of the participants reported getting more than \$150,000/year (N=5, 1.5%). Moreover, 88 participants (26.6%) reported getting between \$50,000 and \$75,000 annually, 67 (20.2%) reported getting between \$75,000 and \$100,000, 21 (6.3%) reported getting between \$100,000 and \$125,000, and 14 (4.2%) reported getting between \$125,000 and \$150,000. This question had 10 missing values, as some of the participants wrote notes on the survey expressing that they did not feel comfortable on sharing such information.

With respect to employment status, the largest proportion of participants (N=223) reported being retired and not working, comprising 67.4%. The second largest group comprised 10.6% of the total participants (N=35) and were those people who were retired, but still working part-time. Following, were those who were unemployed (N=31, 9.4%) and the group of participants who were employed full-time (N=24, 7.3%). At the bottom of this list were those participants who were employed part-time (N=9, 2.7%) and those who were retired and employed full-time (N=8, 2.4%).

Regarding self-reported health status, most of the participants reported as having a good health condition (N=181, 54.7%), followed by excellent health condition (N=84, 25.4%). A total of 61 (18.4%) of the participants reported as having a fair health condition and 4 participants (1.2%) reported as having a poor health condition. When looking deeply into participants' health problems, arthritis, back problems, and knee problems were among the most prevalent health issues reported. Table six shows the summary of the description of demographic characteristics of the sample.

Table 6

Demographic Profiles of the Participants

	Demographic Characteristics	Frequency (n)	Percent (%)
Age			
	55-64 years	43	13
	65-74 years	142	42.9
	75-84 years	104	31.4
	85 years or older	42	12.7
Gender			
	Male	131	39.6
	Female	200	60.4
Marital status			
	Married	218	65.9
	Widowed	73	22.1
	Divorced	27	8.2
	Separated	2	0.6
	Never married	11	3.3
Education			
	Some high school (not completed)	4	1.2
	High school	54	16.3
	Some college	77	23.3
	Trade/technical/vocational training	27	8.2
	Associate degree	24	7.3
	Bachelor's degree	67	20.2
	Professional degree	3	0.9
	Master's degree	55	16.6
	Doctorate degree	16	4.8
	No answer	4	1.2
Income			
	Under $50,000	126	38.1
	$50,000 to less than $75,000	88	26.6
	$75,000 to less than $100,000	67	20.2
	$100,000 to less than $125,000	21	6.3
	$125,000 to less than $150,000	14	4.2
	$150,000 or above	5	1.5
	No answer	10	3.0
Employment status			
	Unemployed	31	9.4
	Retired and not working	223	67.4
	Retired and employed (or self-employed) part-time	35	10.6
	Retired and employed (or self-employed) full-time	8	2.4
	Employed or self-employed part-time	9	2.7
	Employed or self-employed full-time	24	7.3
	No answer	1	0.3

Attitudes towards aging was investigated using 11 questions from the Attitudes to Ageing Questionnaire (AAQ) (Laidlaw et al., 2007; Shenkin et al., 2014). The questions from the AAQ are divided into three factors: psychosocial loss, physical change, and psychological growth. In this study, a total of four questions were concerning psychosocial loss, four concerning physical change, and three concerning psychological growth.

The majority of the participants had overall positive attitudes towards aging, being 275 (83.58%) the number of participants considering the aging process a positive or a very positive period of their lives. A hundred sixty-six (50.2%) participants had a positive and 109 (32.9%) a very positive attitude towards aging.

When divided into the three factors mentioned above, we can be elucidated about how participants in this study were facing the changes in their lives caused by the aging process. In terms of psychosocial loss, that is the psychological and social factors that influence mental health, for example, facing depression or loneliness, 72.8% (N=241) had positive or very positive attitudes towards psychosocial loss, which could mean that they were not experiencing much of psychosocial loss. On the other hand, about 26.6% (N=88) had negative or very negative attitudes towards psychosocial loss. With regards to physical change, 65.6% (N=217) had positive or very positive attitudes towards physical change and 33.9% (N=112) had negative or very negative attitudes towards physical change. Lastly, in terms of psychological growth, about 82.5% (N=273) felt wiser and privileged for growing older, and 16.9% (N=56) had negative or very negative experience with psychological growth in their aging process. Table seven summarizes this information.

Table 7

Frequency of Attitudes Towards Aging

Attitudes Towards Aging		Frequency (n)	Percent (%)
Attitudes Towards Aging (total)			
	Very Positive	109	32.9
	Positive	166	50.2
	Negative	53	16
	Very Negative	1	0.3
	No Answer	2	0.6
Psychosocial loss			
	Very Positive	114	34.4
	Positive	127	38.4
	Negative	71	21.5
	Very Negative	17	5.1
	No Answer	2	0.6
Physical change			
	Very Positive	93	28.1
	Positive	124	37.5
	Negative	81	24.5
	Very Negative	31	9.4
	No Answer	2	0.6
Psychological growth			
	Very Positive	146	44.1
	Positive	127	38.4
	Negative	47	14.2
	Very Negative	9	2.7
	No Answer	2	0.6

Housing Characteristics of the Sample

The majority of the respondents lived in the city suburb (N=138, 41.7%) and in the city (N=121, 36.6%). Approximately 87% (N=287) of the participants lived in a single family detached home. Similarly, 86.1% (N=285) owned their homes, while 11.5% rented their homes, and 1.5% manifested that they lived with other family members. The length of time the participants lived in their current home was broadly distributed from one to 20 years. Twenty-six percent of the participants reported they had lived in their current homes less than 5 years, 15.4% between 6 and 10 years, 25.7% between 11 to 20 years, and 14.2% between 21 to 30 years. The age of participants' homes did not show a specific pattern. Housing characteristics are summarized in Table eight.

Table 8

Reported Housing Characteristics of the Sample

Housing Characteristics		Frequency (n)	Percent (%)
Location			
	Rural area	39	11.8
	Small town	30	9.1
	City suburb	138	41.7
	City	121	36.6
Housing Type			
	Single-family detached home	287	86.7
	Multi-unit building	19	5.7
	Mobile home	3	0.9
	Semi-detached home	9	2.7
	Other	9	2.7
Housing Proprietorship			
	Own	285	86.1
	Rent	38	11.5
	Other	5	1.5
Length in current dwelling			
	Less than 5 years	87	26.3
	6 to 10 years	51	15.4
	11 to 20 years	85	25.7
	21 to 30 years	47	14.2
	31 to 40 years	23	6.9
	41 to 50 years	27	8.2
	Over 50 years	7	2.1
Age of dwelling			
	Before 1950	23	6.9
	1951 to 1960	32	9.7
	1961 to 1970	29	8.8
	1971 to 1980	47	14.2
	1981 to 1990	35	10.6
	1991 to 2000	40	12.1
	2001 to 2010	72	21.8
	After 2010	25	7.6
	I don't know	27	8.2

When participants were asked about their opinions about the interior design of their residences, they were asked to rate interior design under six aesthetics factors: enjoyable, nice looking, pleasing, attractive, good appearance, and beautiful. The large majority of the participants (76%, N=252) had good perceptions about the interior design of their residences. Table nine presents interior design rated by age group, education level and income.

Table 9

Perceived Interior Design, divided by Age, Education, and Income

	very bad appearance (%)	bad appearance (%)	good appearance (%)	very good appearance (%)
Age Groups				
55 to 64 years old	-	4.7	23.3	72.1
65 to 74 years old	0.7	5.6	16.2	76.8
75 to 84 years old	-	7.7	23.1	97.1
85 years or older	-	16.7	33.3	42.9
Education Level				
Some high school	-	-	50	50
High school	-	18.5	25.9	48.1
Some college	1.3	6.5	26	66.2
Trade/technical training	-	11.1	33.3	55.6
Associate degree	-	8.3	12.5	79.2
Bachelor's degree	-	4.5	11.9	82.1
Professional degree	-	-	33.3	66.7
Master's degree	-	1.8	23.6	74.5
Doctorate degree	-	6.3	6.3	87.5
Income				
Under $50,000	-	12.7	31.7	54
$50,000 to less than $75,000	1.1	5.7	21.6	98.9
$75,000 to less than $100,000	-	3	13.4	83.6
$100,000 to less than $125,000	-	4.8	9.5	85.7
$125,000 to less than $150,000	-	7.1	-	92.9
$150,000 or above	-	-	-	100
Interior Design in the total sample	0.3	7.6	21.5	68.6

In addition, over half of the participants (67.4%, N=223) indicated they had not considered any home modification in the past five years. In total, about 72.5% of the participants (N=240) had not made any home modification and about 25.4% (N=84) of the participants had made some modifications in their home environments. Among those who have considered or made some modification, around 49% indicated that the reasons for making the modifications were to improve comfort and convenience, 16% to improve safety, 4.2% for independence, and 1.8% indicated other reasons.

Home modifications were mainly made in the bathrooms with installment of grab-bars or bathroom renovations installing taller toilets, changing from bath tubs to showers, and building wheelchair accessible showers. With regards to other places in the house, participants made house modifications by installing ramps in front doors, removing doors for wheelchair access, improving lighting, installing stair rails, and changing doorknobs to door lever handlers.

Aging-in-Place

Approximately 58% of the participants (N=193) had the plan to continue living in their current residence for the next 10 years, while 28.7% (N=95) indicated that they do not know. Around 13% (N=42) mentioned that they do not think that they will be living in their current residences 10 years from now. Almost half of the participants (N=155) reported that they had not really thought about where they will be living 10 years from now, while 22.1% (N=73) reported that they had fairly defined plans. About 21.8% (N=72) indicated that they had begun talking about the subject, and around 9.1% (N=30) had explored options for future living. In terms of preferences for aging-in-place, about 83% (N=275) of the respondents strongly agreed (74.3%) or somewhat agreed (8.8%) with the statement: *I prefer to remain living in my current residence for as long as possible*, while 6.3% (N=21) somewhat disagreed (2.1%) or strongly disagreed (4.2%), and 10% (N=33) were neutral about the statement. Table 10 presents a summary on aging-in-place.

Table 10

Frequency of Desire for Aging-in-Place

	Total	Age groups			
		55-64	65-74	75-84	85+
	(%)	(%)	(%)	(%)	(%)
Plan to live in the current residence for more than 10 years					
Yes	58.3	62.8	68.3	46.2	50
No	12.7	16.3	9.2	14.4	16.7
I don't know	28.7	20.9	22.5	38.5	33.3
Have made plans for where to live 10 years from now					
Definite plans	22.1	16.3	21.1	23.1	28.6
Explored options	9.1	16.3	8.5	5.8	11.9
Have begun to talk about it	21.8	18.6	27.5	19.2	11.9
Haven't really thought about it	46.8	48.8	43	51	47.6
Degree of agreement with statement about wanting to live in current residence as long as possible					
Strongly agree	74.3	67.4	73.9	77.9	73.8
Somewhat agree	8.8	11.6	11.3	5.8	4.8
Neutral	10	14	8.5	7.8	16.7
Somewhat disagree	2.1	4.7	1.4	2.9	-
Strongly disagree	4.2	2.3	4.9	3.8	4.8

When presented with different options about living preferences other than remain living in their current residence for as long as possible, participants did not present a strong pattern in their responses. Around 33% (N=110) of the participants were neutral when asked if they would prefer to seek a higher level of care, therefore moving to a different environment as their needs change. But similarly, 34% (N=114) would seek for a higher level of care, and 31% (N=104) would not move to another place. In addition, when asked if other people's perceptions about their loss of independence would influence them on moving to a place that could provide higher level of care, around 40% (N=133) were neutral, 29.9% (N=99) would agree or strongly agree, and 29.3% (N=97) would disagree or strongly disagree. Finally, when asked if they would rely more on family or friends to provide more assistance for them rather them looking for community resources, their answers did not present strong preferences. Around 37% said they would rely on family, 28% were neutral, and 33% would not rely on family. With regards to their social network, 20% would rely on friends, around 38% were neutral, and 41.6% would not rely on their social network for assistance.

Among those who strongly agreed or somewhat agreed with the statement *I prefer to remain living in my current residence for as long as possible*, approximately 40% (N=109) answered that they would consider making housing repairs in order to overcome constraints in their home environments. Around 17% (N=48) said that they would consider to move, 12.2% (N=35) would continue living in their current residences without making changes, 11.7% (N=32) do not know how they would overcome the constraints, and 10.2% (N=28) would ask for help from family. Around 5% (N=14) would ask for help from friends, and 2.2% (N=6) would overcome constraints in some other ways.

When asked about the main reason their home might present problems that would affect their possibility of aging-in-place, 63.6% (N=173) of those participants willing to age-in-place said that they do not expect to face any problem with their house. On the other hand, around 15% (N=42) reported that their house is hard to maintain, 7.7% (N=21) reported that their house is too big, and 5.5% (N=15) said that their house has an inconvenient design. Around 6% (N=17) said that their house might present other problems, and just 1.4% (N=4) said that their house is too old.

As for questions about problems related to the neighborhood, around 38% (N=104) of the participants reported that other problems that were not listed would be a problem that might influence them on moving in the future. Among these problems were: the neighborhood is located in a tornado alley, sloping street, difficult roads, no close family, and financial problems like high taxes and insurance. Around 17% (N=47) said that it is hard to get housekeeping in current house, and 15.7% (N=43) indicated safety issues. Around 7.3% (N=20) said the problem might be the neighborhood they live in, and 4.7% (N=13) said that they live in a place where it is hard to get medical services. Just one person (0.3%) said that they live in a place where it is hard to get emergency services, and another person said that they live in a bad location.

Most of the participants (70.7%, N=234) did not report any fall in their home environment in the past three years. Among those who reported a fall (N=92), 11 participants (12%) were hospitalized one or twice, and three participants (3.2%) were hospitalized three or four times. These results may explain the reasons for low fear of falling among the participants. Around 73% (N=241) indicated overall no fear or very little concern of falling in their home environment while performing activities of daily living (ADL) and/or instrumental activities of daily living (IADL). Around 13% (N=43) indicated a little bit of concern, 9% (N=30) indicated some concern, and 2.7% (N=9) were very concerned about falling at home. Reaching for something above their head or on the ground was the activity that most participants reported having at least a little bit of concern to perform (42.3%, N=140). Taking a bath or shower comes next (39.8%, N=132), followed by using the stairs (33.5%, N=111). Getting in or out of a chair was reported by 90 participants (27.2%), cleaning the house by 87 (26.3%), getting dressed by 71 (21.5%), and preparing simple meals also by 71 participants (21.5%). The places where participants reported their falls in the home environment were living room (N=33), bedroom (N=21), bathroom (N=19), garage (N=14), kitchen (N=12), stairs (N=7), dining room (N=6), corridor (N=5), laundry (N=3), other rooms (N=3), other locations (N=34). Among the other locations were either the front or the back yard.

Older Adults and Technology

A list of 20 different technological devices was presented to the participants where they were asked to indicate the ones they owned. The technological devices varied from DVD player and microwave until wireless health monitoring system and voice-recognition door opener. Microwave oven is the most popular item, being present in the residences of 93.7% (N=310) of the participants. Following, 81.6% (N=270) owned DVD player and a satellite or cable TV. Computer was owned by 79.5% (N=263), Wi-Fi was present in the residences of 73.4% (N=243), and smartphone was owned by 73.1% (N=242) of participants. These were the most largely used technological devices and services among the participants.

Following the list, burglar alarm was present in 51.1% (N=169) of the residences, gas leak detector alarm in 45.9% (N=152) of the residences, and electric tooth brush was owned by 43.2% (N=143) of participants. Around 19% (N=64) of participants owned a remote control for temperature or humidity, 15.4% (N=51) owned a home theater system, and 11.8% (N=39) owned remote control for turning on/off lighting and dimming lamps.

At the bottom of this list are the technological devices owned by less than 10% of the participants. An emergency alert device, like a pendant that can send a signal when a person presses a button in case of an emergency, was owned by 8.5% (N=28) of participants. Personal health remote diagnostic product, like a diabetes check device, was owned by 6% (N=20) of participants. Likewise, video-cameras for activity monitoring is present in the house of 6% of participants. Wireless health monitoring device, like a necklace or a watch that can monitor and send alert if unsafe heartbeats are detected, was owned by 3.9% (N=13) of participants. Also, 3.9% owned a video-phone at entrance. Around 3% (N=11) owned remote control for home appliances, and 1.8% (N=6) owned remote control for rising/lowering shutters, and also 1.8% had a voice-recognition door opener. Table 11 presents the technological devices owned by the participants divided by age groups.

Table 11

Technological devices owned by the participants, divided by age groups

Devices	**Age Groups** 55-64 (%)	65-74 (%)	75-84 (%)	85+ (%)
DVD Player	93	85.2	76	71.4
Computer	88.4	85.2	76.9	57.1
Smartphone	86	85.9	62.5	42.9
Wi-Fi	81.4	81.7	67.3	52.4
Satellite or cable TV	67.4	84.5	82.7	83.3
Microwave oven	90.7	96.5	93.3	88.1
Electric tooth brush	27.9	47.2	41.3	50
Video-phone at entrance	4.7	3.5	3.8	4.8
Voice-recognition door opener	2.3	1.4	1	4.8
Burglar alarm	48.8	57	48.1	40.5
Gas leak detector alarm	46.5	46.5	44.2	47.6
Remote controls for temperature or humidity	18.6	14.1	24	26.2
Remote controls for turning on/off lighting	16.3	9.9	10.6	16.7
Remote control for rising/lowering shutters	-	1.4	3.8	-
Remote control for home appliance	-	3.5	3.8	4.8
Home theater system	30.2	20.4	6.7	4.8
Personal health remote diagnostic product	7	5.6	6.7	4.8
Wireless health monitoring product	2.3	2.1	3.8	11.9
Emergency alert product	4.7	3.5	12.5	23.8
Video-cameras for activity monitoring	9.3	8.5	1.9	4.8

When asked about how they learn about new technological home products, 58% (N=192) of participants indicated that they agree or strongly agree that other people, like family and friends have been a good source of information. TV comes in second on being a good source of information about new technology (49.8%, N=165). Internet was indicated as good source of information by 42% (N=139) of participants. Newspaper was considered a good source of information about new technology by 24.5% (N=81), and radio was indicated by 12.7% (N=42) of participants.

In this study, technology readiness is the older adults' propensity to embrace new technologies to perform daily activities. According to the participants' responses, 60.7% (N=201) of the participants were not ready for embracing new technologies, and 36.5 (N=121) felt ready to embrace new technologies. The Technology Readiness Index (TRI) 2.0 (Parasuraman & Colby, 2014) gives the opportunity to understand participants' levels of optimism, insecurity, innovativeness, and discomfort towards new technologies. Optimism is "a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives" (Parasuraman & Colby, 2014, p.60). Insecurity is "distrust of technology, stemming from skepticism about its ability to work properly and concerns about its potential harmful consequences" (Parasuraman & Colby, 2014, p.60). Innovativeness is "a tendency to be a technology pioneer and thought leader" (Parasuraman & Colby, 2014, p.60). Discomfort is "a perceived lack of control over technology and a feeling of being overwhelmed by it" (Parasuraman & Colby, 2014, p.60).

When looking the data to understand participants' levels of optimism, insecurity, innovativeness, and discomfort towards new technologies, 55% (N=182) were optimists or very optimists and 42.3 (N=140) were pessimists or very pessimists towards new technology. It is interesting to notice that the same number of optimists felt insecure about the use of new technology (N=182, 55%) and the same number of pessimists felt secure about using new technology (N=140, 42.3%). However, this does not mean that they were the same group of people. With regards to levels of innovativeness, the majority of the participants (N=237, 71.6%) did not feel innovative, and 25.7% (N=85) feel innovative towards new technology. Lastly, with regards of levels of discomfort on using new technology, around 64% (N=213) of participants felt comfortable using new technology and 33% (N=109) did not feel comfortable using new technology. Table 12 summarizes results about technology readiness.

Table 12

Frequency of Technology Readiness

Technology Readiness		Frequency (n)	Percent (%)
Technology Readiness Total			
	Strongly ready	19	5.7
	Somewhat ready	102	30.8
	Somewhat not ready	164	49.5
	Strongly not ready	37	11.2
Optimism			
	Highly optimist	93	28.1
	Somewhat optimist	89	26.9
	Somewhat pessimist	105	31.7
	Highly pessimist	35	10.6
Insecurity			
	Highly secure	56	16.9
	Somewhat secure	84	25.4
	Somewhat insecure	95	28.7
	Highly insecure	87	26.3
Innovativeness			
	Very innovative	25	7.6
	Innovative	60	18.1
	Low innovative	106	32
	Very low innovative	131	39.6
Discomfort			
	Highly comfortable	108	32.6
	Somewhat comfortable	105	31.7
	Somewhat uncomfortable	55	16.6
	Highly uncomfortable	54	16.3

Fall Prevention, Fall Detection and Fall Monitoring Gerontechnology

Knowledge on fall prevention, fall detection and fall monitoring gerontechnology

When asked about perceived knowledge on fall prevention gerontechnology, 22.3% (N=74) felt knowledgeable, 11.2% (N=37) were neutral, and 62.9% (N=208) did not feel knowledgeable on fall prevention gerontechnology. When asked about perceived knowledge on fall detection gerontechnology, 17.8% (N=59) felt knowledgeable, 15.7% (N=52) were neutral, and 61.5% (N=204) did not feel knowledgeable on fall detection gerontechnology. Finally, when asked about perceived knowledge on fall monitoring gerontechnology, 18.7% (N=62) felt knowledgeable, 19.6% (N=65) were neutral, and 57.2% (N=190) did not feel knowledgeable on fall monitoring gerontechnology. Table 13 summarizes results about perceived knowledge on fall prevention, fall detection, and fall monitoring gerontechnologies.

Table 13

Perceived Knowledge on Fall Prevention, Fall Detection, and Fall Monitoring Gerontechnology

Perceived knowledge		Frequency (n)	Percent (%)
Fall Prevention Gerontechnology			
	High knowledge	15	4.5
	Some knowledge	59	17.8
	Neutral	37	11.2
	Low knowledge	130	39.4
	No knowledge	78	23.5
	No answer	12	3.6
Fall Detection Gerontechnology			
	High knowledge	6	1.8
	Some knowledge	53	16
	Neutral	52	15.7
	Low knowledge	108	32.6
	No knowledge	96	28.9
	No answer	16	4.8
Fall Monitoring Gerontechnology			
	High knowledge	7	2.1
	Some knowledge	55	16.6
	Neutral	65	19.6
	Low knowledge	91	27.3
	No knowledge	99	29.9
	No answer	14	4.2

Attitudes towards fall prevention, fall detection and fall monitoring gerontechnology

When asked about attitudes towards fall prevention gerontechnology, 55.6% (N=184) had a positive attitude towards fall prevention gerontechnology, 30.8% (N=102) were neutral, and 9% (N=30) had a negative attitude towards fall prevention gerontechnology**.** When asked about attitudes towards fall detection gerontechnology, 52.2% (N=173) had a positive attitude towards fall detection gerontechnology, 31.4% (N=104) were neutral, and 12% (N=40) had a negative attitude towards fall detection gerontechnology. When asked about attitudes towards fall monitoring gerontechnology, 49.4% (N=164) had a positive attitude towards fall monitoring gerontechnology, 30.5% (N=101) were neutral, and 15.3% (N=51) had a negative attitude towards fall monitoring gerontechnology. Table 14 summarizes results about attitudes towards fall prevention, fall detection, and fall monitoring gerontechnologies.

Table 14

Attitudes Towards Fall Prevention, Fall Detection and Fall Monitoring Gerontechnology

Attitudes Towards	Frequency (n)	Percent (%)
Fall Prevention Gerontechnology		
Very positive	76	23
Positive	108	32.6
Neutral	102	30.8
Negative	21	6.3
Very negative	9	2.7
No answer	15	4.5
Fall Detection Gerontechnology		
Very positive	84	25.4
Positive	89	26.8
Neutral	104	31.4
Negative	26	7.8
Very negative	14	4.2
No answer	14	4.2
Fall Monitoring Gerontechnology		
Very positive	81	24.4
Positive	83	25
Neutral	101	30.5
Negative	35	10.5
Very negative	16	4.8
No answer	15	4.5

Attitudes towards benefits of aging-in-place promoted by fall prevention, fall detection and fall monitoring gerontechnology

Benefits were considered the possibilities the device would be able to promote aging-in-place. When asked about attitudes towards benefits of fall prevention gerontechnology, 42.5% (N=141) had a positive attitude towards benefits of fall prevention gerontechnology, 29% (N=96) were neutral, and 24.3% (N=81) had a negative attitude towards benefits of fall prevention gerontechnology. When asked about attitudes towards benefits of fall detection gerontechnology, 46.9% (N=155) had a positive attitude towards benefits of fall detection gerontechnology, 31.7% (N=105) were neutral, and 16.2% (N=54) had a negative attitude towards benefits of fall detection gerontechnology. When asked about attitudes towards benefits of fall monitoring gerontechnology, 32.5% (N=108) had a positive attitude towards fall monitoring gerontechnology, 29.6% (N=98) were neutral, and 33.1% (N=110) had a negative attitude towards benefits of fall monitoring gerontechnology. Table 15 summarizes results about attitudes towards benefits of fall prevention, fall detection, and fall monitoring gerontechnologies.

Table 15

Attitudes Towards Benefits of Aging-in-place promoted by Fall Prevention, Fall Detection and Fall Monitoring Gerontechnology

Attitudes Towards Benefits	**Frequency (n)**	**Percent (%)**
Fall Prevention Gerontechnology		
Very positive	60	18.1
Positive	81	24.4
Neutral	96	29
Negative	51	15.3
Very negative	30	9
Fall Detection Gerontechnology		
Very positive	66	19.9
Positive	89	27
Neutral	105	31.7
Negative	29	8.7
Very negative	25	7.5
Fall Monitoring Gerontechnology		
Very positive	50	15.1
Positive	58	17.4
Neutral	98	26.6
Negative	70	21.1
Very negative	40	12

Purchase intention of fall prevention, fall detection and fall monitoring gerontechnology

When asked about purchase intention of fall prevention gerontechnology, 12.4% (N=41) said that they were likely to purchase, 32.3% (N=107) were neutral, and 50.4% (N=167) said that they were unlikely to purchase fall prevention gerontechnology. If purchased, 33.5% (N=111) said that they were likely to use, 22.4% (N=74) were neutral, and 39.3% (N=130) were unlikely to use fall prevention gerontechnology. When asked about purchase intention of fall detection gerontechnology, 13% (N=43) said they were likely to purchase, 31.7% (N=105) were neutral, and 50.4% (N=167) said that they were unlikely to purchase fall detection gerontechnology. If purchased, 33.2% (N=110) said they were likely to use, 29% (N=96) were neutral, and 33% (N=109) said they were unlikely to use fall detection gerontechnology. When asked about purchase intention of fall monitoring gerontechnology, 11.8% (N=39) said they were likely to purchase, 29% (N=96) were neutral, and 54.4% (N=180) said they were unlikely to purchase fall monitoring gerontechnology. If purchased, 31.7% (N=105) said they were likely to use, 28.1% (N=93) were neutral, 35.1% (N=116) said they were unlikely to use fall monitoring gerontechnology. Table 16 summarizes results about purchase intention and use intention of fall prevention, fall detection, and fall monitoring gerontechnologies.

Table 16

Purchase Intention and Use Intention of Fall Prevention, Fall Detection, and Fall Monitoring Gerontechnology

	Purchase Intention		Use Intention	
	Frequency (n)	**Percent (%)**	**Frequency (n)**	**Percent (%)**
Fall Prevention Gerontechnology				
Very likely	14	4.2	54	16.3
Likely	27	8.2	57	17.2
Neutral	107	32.3	74	22.4
Unlikely	60	18.1	55	16.6
Very unlikely	107	32.3	75	22.7
No answer	16	4.8	16	4.8
Fall Detection Gerontechnology				
Very likely	16	4.8	61	18.4
Likely	27	8.2	49	14.8
Neutral	105	31.7	96	29
Unlikely	55	16.6	37	11.2
Very unlikely	112	33.8	72	21.8
No answer	16	4.8	16	4.8
Fall Monitoring Gerontechnology				
Very likely	15	4.5	59	17.8
Likely	24	7.3	46	13.9
Neutral	96	29	93	28.1
Unlikely	55	16.6	36	10.9
Very unlikely	125	37.8	80	24.2
No answer	16	4.8	17	5.1

Test of Hypotheses

A total of 15 hypotheses were proposed in this research for each fall prevention, fall detection, and fall monitoring gerontechnologies. For the purpose of organization, some hypotheses were arranged together in a total of eight groups. Some of these groups have hypothesis a, hypothesis b, and hypothesis c, totalizing 15 hypotheses tests.

To examine the following hypotheses, path analysis through a series of multiple regressions were employed to analyze the paths in the operational model developed in this research. To further understand some of the connections, a series of simple linear regressions were used to explore relationships between independent and dependent variables that were not significant using multiple regression analysis. Then, indirect and total effects were explored in the main path of the model (knowledge, persuasion and decision stage) when there was at least one significant direct effect in each stage.

Path analysis was developed as a method of studying direct and indirect effects of variables. Path analysis was intended not to discover causes but to shed light on the tenability of the causal models a researcher formulates based on theoretical considerations (Garson, 2014; Jeon, 2015). One of the advantages of path analysis is that it affords the decomposition of correlations among variables, thereby enhancing the interpretation of relations as well as the pattern of effects of one variable on another. In this study, an alpha of 0.05 was adopted to evaluate if relationships between variables were statistical significant.

Fall Prevention Gerontechnology

In order to explore relationships proposed in the operational model for the decision-process of fall prevention gerontechnology (Figure 8), four multiple regression analyses were employed.

The first multiple regression model tested the relationships of desire to age-in-place, technology readiness, sources of information, aging attitudes, fear of falling (independent variables) and perceived knowledge on fall prevention gerontechnology (dependent variable). This model tested the following hypotheses:

H3a. Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall prevention gerontechnology.

H4a. Technology readiness will have a positive effect on an individual's perceived knowledge on fall prevention gerontechnology.

H6a. Sources of information will be correlated to an individual's perceived knowledge on fall prevention gerontechnology.

H7. A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall prevention gerontechnology.

H8. Fear of falling will have a positive effect on perceived knowledge on fall prevention gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.682. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the five independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is not a significant proportion of the total variation in perceived knowledge on fall prevention gerontechnology predicted by desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling, $F(5,312) = 1.907$, $p = 0.093$. The results of regression analysis did not show any significant variables ($p<0.05$). Table 17 presents the result of multiple regression analysis.

Table 17

Fall Prevention Gerontechnology – Path Analysis Result: Coefficients of Path Model 1

Model 1	**β**	**t-value**	***p***
Desire to age-in-place	.05	.98	.32
Technology Readiness	.08	.40	.16
Sources of Information	.11	.95	.05
Aging Attitudes	-.02	-.43	.66
Fear of Falling	.02	.35	.72
R^2	.03		
F change	1.907		

Note. Dependent Variable: Perceived Knowledge on Fall Prevention Gerontechnology.

With the results from the analysis of Model 1, none of the hypotheses tested were supported. In other words, desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling (independent variables) did not predict perceived knowledge on fall prevention gerontechnology (dependent variable).

After testing Model 1, a series of simple linear regressions were conducted to identify if any of the independent variables would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that technology readiness and was statistically significant on predicting perceived knowledge on fall prevention gerontechnology when not controlling for the other predictors as reported below. In addition, sources of information appeared to be correlated to the dependent variable.

First, a simple linear regression analysis was conducted to determine if perceived knowledge on fall prevention gerontechnology could be predicted from technology readiness. The results of the simple linear regression suggested that a significant proportion of the total variation in perceived knowledge on fall prevention gerontechnology was predicted by technology readiness. In other words, older adults' level of technology readiness was a good predictor of older adults' perceived knowledge on fall prevention gerontechnology, $F(1, 317) = 4.221$, $p = .041$. Additionally, the unstandardized slope (.139) and standardized slope (.115) are statistically significantly different from zero ($t = 2.054$, $df = 317$, $p = .041$), and the intercept (or average perceived knowledge on fall prevention gerontechnology score when technology readiness is zero) was 2.111. Multiple R^2 indicates that approximately 1% of the variation in perceived knowledge on fall prevention gerontechnology was predicted by technology readiness. According to Cohen (1988), this suggests a small effect.

Then, a simple linear regression analysis was conducted to determine if perceived knowledge on fall prevention gerontechnology has a correlation with sources of information. The results of the simple linear regression suggest that a significant proportion of the total variation in perceived knowledge on fall prevention gerontechnology was predicted by sources of information. In other words, sources of information is correlated with older adults' perceived knowledge on fall prevention gerontechnology, $F(1, 317) = 6.204$, $p = .013$. Additionally, the unstandardized slope (.161) and standardized slope (.139) are statistically significantly different from zero ($t = 2.491$, $df = 317$, $p = .013$), and the intercept (or average perceived knowledge on fall prevention gerontechnology score when sources of information is zero) was 2.021. Multiple R^2 indicates that approximately 1% of the variation in perceived knowledge on fall prevention gerontechnology was predicted by sources of information. According to Cohen (1988), this suggests a small effect.

After the statistically significant predictors were identified (technology readiness and sources of information), a multiple linear regression with just the two independent variables was conducted to analyze if together the model is statistically significant. The results of the multiple linear regression suggest that there is a significant proportion of the total variation in perceived knowledge on fall prevention gerontechnology predicted by technology readiness and sources of information, $F(2,316) = 4.154$, $p = .017$. Multiple R^2 indicates that approximately 2% of the variation in perceived knowledge on fall prevention gerontechnology was predicted by technology readiness and sources of information. According to Cohen (1988), this suggests a small effect.

The second multiple regression model tested the relationships of perceived knowledge on fall prevention gerontechnology, technology readiness, interior design aesthetics, sources of information (independent variables) and attitudes towards fall prevention gerontechnology (dependent variable). This model tested the following hypotheses:

H1a. Perceived knowledge on fall prevention gerontechnology will have a positive effect on attitudes towards fall prevention gerontechnology.

H4b. Technology readiness will have a positive effect on an individual's attitudes towards fall prevention gerontechnology.

H5a. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall prevention gerontechnology.

H6b. Sources of information will be correlated to an individual's attitudes towards fall prevention gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.951. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in attitudes towards fall prevention gerontechnology predicted by perceived knowledge on fall prevention gerontechnology, technology readiness, interior design aesthetics, and sources of information, $F(4,311) = 5.741$, $p = 0.000$. Multiple R square indicates that approximately 6% of the variation in attitudes towards fall prevention gerontechnology was predicted by the group of independent variables. According to Cohen (1988), this suggests a small effect. The results of regression analysis showed two significant variables ($p<0.05$). The variables were perceived knowledge of fall prevention gerontechnology ($\beta = 0.156$) and sources of information ($\beta = 0.117$) (see Table 18). Standardized coefficients showed that perceived knowledge of fall prevention gerontechnology had the biggest impact on attitudes towards fall prevention gerontechnology among other variables. The direct effect of these variables on attitudes towards fall prevention gerontechnology is shown in Figure 10 (after path analysis test).

Table 18

Fall Prevention Gerontechnology – Path Analysis Result: Coefficients of Path Model 2

Model 2	**β**	**t-value**	***p***
Perceived Knowledge on Fall Prevention Gerontechnology	.15	2.79*	.00
Technology Readiness	.11	1.89	.06
Interior Design	-.07	-1.31	.18
Sources of Information	.11	2.02*	.04
R^2	.69		
F change	5.74		

Note. Dependent Variable: Attitudes Towards Fall Prevention Gerontechnology
*p<.05

With the results from the analysis of Model 2, two of the hypotheses tested were supported (hypotheses 1a and 6b). In other words, perceived knowledge on fall prevention gerontechnology (independent variable) predicted attitudes towards fall prevention gerontechnology (dependent variable). In addition, sources of information were correlated to the dependent variable.

After testing Model 2, a series of simple linear regressions were conducted to identify if any of the independent variables that were not statistically significant in the model would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that technology readiness was statistically significant on predicting perceived knowledge on fall prevention gerontechnology when not controlling for the other predictors as reported below.

The results of the simple linear regression suggest that a significant proportion of the total variation in attitudes towards fall prevention gerontechnology was predicted by technology readiness. In other words, older adults' level of technology readiness is a good predictor of older adults' attitudes towards fall prevention gerontechnology, $F(1, 314) = 7.330$, $p = .007$. Additionally, the unstandardized slope (.187) and standardized slope (.151) are statistically significantly different from zero ($t = 2.707$, $df = 314$, $p = .007$), and the intercept (or average attitudes towards fall prevention gerontechnology score when technology readiness is zero) was 3.014. Multiple R squared indicates that approximately 2% of the variation in attitudes towards fall prevention gerontechnology was predicted by technology readiness. According to Cohen (1988), this suggests a small effect.

The third multiple regression model tested the relationships of perceived knowledge on fall prevention gerontechnology, desire to age-in-place (independent variables) and attitudes towards benefits of fall prevention gerontechnology (dependent variable). This model tested the following hypotheses:

H1b. Perceived knowledge on fall prevention gerontechnology will have a positive effect on attitudes towards benefits of fall prevention gerontechnology.

H3b. Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall prevention gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.828. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the two independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in attitudes towards benefits of fall prevention gerontechnology predicted by perceived knowledge on fall prevention gerontechnology and desire to age-in-place, $F(2,315) = 4.859$, $p = 0.008$. Multiple R squared indicates that approximately 2% of the variation in attitudes towards benefits of fall prevention gerontechnology was predicted by perceived knowledge on fall prevention gerontechnology and desire to age-in-place. According to Cohen (1988), this suggests a small effect. The results of regression analysis showed one significant variables ($p<0.05$). The variable was perceived knowledge on fall prevention gerontechnology ($\beta = 0.157$) (see Table 19). The direct effect of this variables on attitudes towards benefits of fall prevention gerontechnology is shown in Figure 10 (after path analysis test).

Table 19

Fall Prevention Gerontechnology – Path Analysis Result: Coefficients of Path Model 3

Model 3	**β**	**t-value**	***p***
Perceived Knowledge on Fall Prevention Gerontechnology	.15	2.82*	.00
Desire to age-in-place	.06	1.14	.25
R^2	.024		
F change	4.86		

Note. Dependent Variable: Attitudes Towards Benefits of Fall Prevention Gerontechnology
*p<.05

With the results from the analysis of Model 3, one of the hypotheses tested was supported (hypothesis 1b). In other words, perceived knowledge on fall prevention gerontechnology (independent variable) predicted attitudes towards benefits of fall prevention gerontechnology (dependent variables).

After testing Model 3, A simple linear regression analysis was conducted to determine if attitudes towards benefits of fall prevention gerontechnology could be predicted by desire to age-in-place when not controlling for perceived knowledge on fall prevention gerontechnology. Results from the analysis suggested that desire to age-in-place was not statistically significant on predicting attitudes towards benefits of fall prevention gerontechnology.

The fourth multiple regression model tested the relationships of attitudes towards fall prevention gerontechnology, attitudes towards benefits of fall prevention gerontechnology, interior design aesthetics of older adults' home environment, sources of information (independent variables) and purchase intention of fall prevention gerontechnology (dependent variable). This model tested the following hypotheses:

H2a. Attitudes towards fall prevention gerontechnology will have a positive effect on purchase intention of fall prevention g gerontechnology.

H2b. Attitudes towards benefits of fall prevention gerontechnology will have a positive effect on purchase intention of fall prevention gerontechnology.

H5b. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall prevention gerontechnology.

H6c. Sources of information will be correlated to an individual's purchase intention of fall prevention gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 2.175. The Durbin-Watson statistic should be

as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in purchase intention of fall prevention gerontechnology predicted by attitudes towards fall prevention gerontechnology, attitudes towards benefits of fall prevention gerontechnology, interior design aesthetics, and sources of information, $F(4,309) = 18.551$, $p = 0.00$. Multiple R squared indicates that approximately 19% of the variation in purchase intention of fall prevention gerontechnology was predicted by attitudes towards fall prevention gerontechnology, attitudes towards benefits of fall prevention gerontechnology, interior design aesthetics, and sources of information. According to Cohen (1988), this suggests a medium to large effect. The results of regression analysis showed one significant variable ($p<0.05$). The variable was attitudes towards fall prevention gerontechnology ($\beta = 0.389$). The direct effect of this variable on purchase intention of fall prevention gerontechnology is shown in Figure 10 (after path analysis test). Table 20 presents the result of multiple regression analysis.

Table 20

Fall Prevention Gerontechnology – Path Analysis Result: Coefficients of Path Model 4

Model 4	**β**	**t-value**	***p***
Sources of Information	.04	.82	.41
Interior Design	-.06	-.17	.24
Attitudes Towards Fall Prevention Gerontechnology	.38	.78*	.00
Attitudes Towards Benefits of Fall Prevention Gerontechnology	.06	.19	.23
R^2	.19		
F change	18.55		

Note. Dependent Variable: Purchase Intention of Fall Prevention Gerontechnology
*p<.05

With the results from the analysis of Model 4, one of the hypotheses tested was supported (hypothesis 2a). In other words, Attitudes Towards Fall Prevention Gerontechnology (independent variable) predicted Purchase Intention of Fall Prevention Gerontechnology (dependent variables).

After testing Model 4, a series of simple linear regressions were conducted to identify if any of the independent variables that were not statistically significant in the model would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that attitudes towards benefits of fall prevention gerontechnology was statistically significant on predicting attitudes towards fall prevention gerontechnology when not controlling for the other predictors as reported below. In addition, sources of information appeared to be correlated to the dependent variable.

First, a simple linear regression analysis was conducted to determine if purchase intention of fall prevention gerontechnology could be predicted from attitudes towards benefits of fall prevention gerontechnology. The results of the simple linear regression suggest that a significant proportion of the total variation in purchase intention of fall prevention gerontechnology was predicted by attitudes towards benefits of fall prevention gerontechnology. In other words, older adults' level of attitudes towards benefits of fall prevention gerontechnology is a good predictor of older adults' purchase intention of fall prevention gerontechnology, $F(1, 312) = 20.963$, $p = .000$.

Additionally, the unstandardized slope (.278) and standardized slope (.251) are statistically significantly different from zero (t = 4.58, df = 312, p = .000), and the intercept (or average purchase intention of fall prevention gerontechnology score when attitudes towards benefits of fall prevention gerontechnology is zero) was 1.403. Multiple R squared indicates that approximately 6% of the variation in purchase intention of fall prevention gerontechnology was predicted by attitudes towards benefits of fall prevention gerontechnology. According to Cohen (1988), this suggests a small effect.

A simple linear regression analysis was conducted to determine if purchase intention of fall prevention gerontechnology was correlated to sources of information. The results of the simple linear regression suggest that a significant proportion of the total variation in purchase intention of fall prevention gerontechnology was correlated to sources of information, $F(1, 313) = 3.56$, p = .049. Additionally, the unstandardized slope (.166) and standardized slope (.106) are statistically significantly different from zero (t = 1.87, df = 313, p = .049), and the intercept (or average purchase intention of fall prevention gerontechnology score when sources of information is zero) was 1.792. Multiple R squared indicates that approximately 1% of the variation in purchase intention of fall prevention gerontechnology was predicted by sources of information. According to Cohen (1988), this suggests a small effect.

Figure 15 presents the significant relationships from path analysis. Just the relationships statistically significant in the multiple regression model tests were reported.

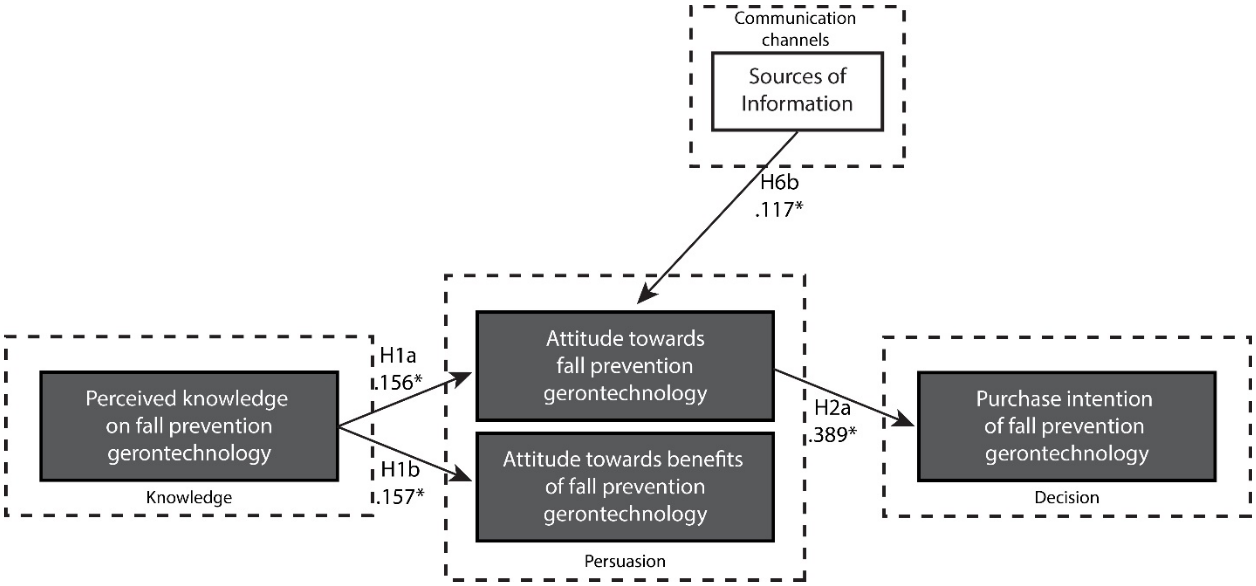

Figure 10. Fall prevention gerontechnology: significant paths from regression analysis. Note: *p<0.05.

After testing direct effects, as the main path had at least one statistically significant direct effect connecting the three stages, a test of indirect and total effects was performed. Multiple regression analyses were conducted to assess each component of the proposed mediation model (Figure 11). First, it was found that perceived knowledge on fall prevention gerontechnology was positively associated with purchase intention of fall prevention gerontechnology (b = 0.2433, $t(310)$ = 3.181, p = 0.001). It was also found that perceived knowledge on fall prevention gerontechnology was positively related to attitudes towards fall prevention gerontechnology (b = 0.157, $t(310)$ = 2.694, p = 0.007). Lastly, results indicated that the mediator, attitudes towards fall prevention gerontechnology, was positively associated with purchase intention of fall prevention gerontechnology (b = 0.559, $t(309)$ = 8.310, p = 0.000). Because both the a-path and b-path were significant, mediation analysis was tested using the bootstrapping method with bias-corrected confidence estimates (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004). In the present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap resamples (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating attitudes towards fall prevention gerontechnology in the relation between perceived knowledge on fall prevention gerontechnology and purchase intention of fall prevention gerontechnology (*b* = 0.088; CI = 0.02 to 0.16). In addition, results indicated that the direct effect of perceived knowledge on fall prevention gerontechnology on purchase intention of fall prevention gerontechnology was significant, but lessened (*b* = 0.155, *t*(309) = 2.221, *p* = 0.02) when controlling for attitudes towards fall prevention gerontechnology, thus suggesting partial mediation. Results are summarized on table 21 and summary of the hypotheses tests is presented on table 22.

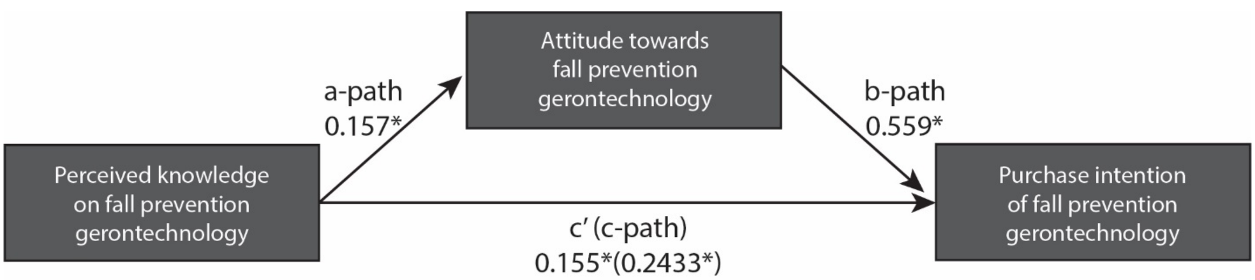

Figure 11. Fall prevention gerontechnology: indirect effect and total effects of perceived knowledge on purchase intention mediated by attitudes towards gerontechnology. Note: *$p<0.05$.

Table 21

Fall prevention Gerontechnology: Mediation Analysis

	b	***t***	***p***
Mediation a-path	.15	2.694	.00
Mediation b-path	.55	8.310	.00
Total effect c-path	.24	2.694	.00
Direct effect c'-path	.15	2.221	.02
Indirect effect a-path x b-path (with bootstrapped 95% confidence interval)	.08 [.02, .16]		

Table 22

Fall Prevention: Summary of Results from Hypotheses Tests

	Hypotheses	Multiple Regression	Simple Linear Regression
H1a	Perceived knowledge on fall prevention gerontechnology will have a positive effect on attitudes towards fall prevention gerontechnology.	**Supported**	**Supported**
H1b	Perceived knowledge on fall prevention gerontechnology will have a positive effect on attitudes towards benefits of fall prevention gerontechnology.	**Supported**	**Supported**
H2a	Attitudes towards fall prevention gerontechnology will have a positive effect on purchase intention of fall prevention g gerontechnology.	**Supported**	**Supported**
H2b	Attitudes towards benefits of fall prevention gerontechnology will have a positive effect on purchase intention of fall prevention gerontechnology.	Not Supported	**Supported**
H3a	Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall prevention gerontechnology.	Not Supported	Not Supported
H3b	Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall prevention gerontechnology.	Not Supported	Not Supported
H4a	Technology readiness will have a positive effect on an individual's perceived knowledge on fall prevention gerontechnology.	Not Supported	**Supported**
H4b	Technology readiness will have a positive effect on an individual's attitudes towards fall prevention gerontechnology.	Not Supported	**Supported**
H5a	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall prevention gerontechnology.	Not Supported	Not Supported
H5b	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall prevention gerontechnology.	Not Supported	Not Supported
H6a	Sources of information will be correlated to an individual's perceived knowledge on fall prevention gerontechnology.	Not Supported	**Supported**
H6b	Sources of information will be correlated to an individual's attitudes towards fall prevention gerontechnology.	**Supported**	**Supported**
H6c	Sources of information will be correlated to an individual's purchase intention of fall prevention gerontechnology.	Not Supported	**Supported**
H7	A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall prevention gerontechnology.	Not Supported	Not Supported
H8	Fear of falling will have a positive effect on perceived knowledge on fall prevention gerontechnology.	Not Supported	Not Supported

Fall Detection Gerontechnology

In order to explore relationships proposed in the operational model for the decision-process of fall detection gerontechnology (Figure 8), four multiple regression analyses were employed.

The first multiple regression model tested the relationships of desire to age-in-place, technology readiness, sources of information, aging attitudes, fear of falling (independent variables) and perceived knowledge on fall detection gerontechnology (dependent variable). This model tested the following hypotheses:

H3a. Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall detection gerontechnology.

H4a. Technology readiness will have a positive effect on an individual's perceived knowledge on fall detection gerontechnology.

H6a. Sources of information will be correlated to an individual's perceived knowledge on fall detection gerontechnology.

H7. A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall detection gerontechnology.

H8. Fear of falling will have a positive effect on perceived knowledge on fall detection gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.779. The Durbin-Watson statistic should be

as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the five independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is not a significant proportion of the total variation in perceived knowledge on fall detection gerontechnology predicted by desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling, $F(5,309) = 1.047$, $p = 0.390$. The results of regression analysis did not show any significant variables ($p<0.05$). Table 23 presents the result of multiple regression analysis.

Table 23

Fall Detection Gerontechnology – Path Analysis Result: Coefficients of Path Model 1

Model 1	**β**	**t-value**	***p***
Desire to age-in-place	.012	.205	.837
Technology Readiness	.070	1.194	.233
Sources of Information	.080	1.347	.179
Aging Attitudes	-.070	-1.119	.231
Fear of Falling	-.026	-.446	.656
R^2	.01		
F change	1.04		

Note. Dependent Variable: Perceived Knowledge on Fall Detection Gerontechnology

With the results from the analysis of Model 1, none of the hypotheses tested were supported. In other words, desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling (independent variables) did not predict perceived knowledge on fall detection gerontechnology (dependent variable).

After testing Model 1, a series of simple linear regression analyses were conducted to determine if any of the independent variables would be statistically significant when not controlling for other predictors. Results from the analyses suggested that none of the independent variables were statistically significant on predicting perceived knowledge on fall detection gerontechnology.

The second multiple regression model tested the relationships of perceived knowledge on fall detection gerontechnology, technology readiness, interior design aesthetics, sources of information (independent variables) and attitudes towards fall detection gerontechnology (dependent variable). This model tested the following hypotheses:

H1a. Perceived knowledge on fall detection gerontechnology will have a positive effect on attitudes towards fall detection gerontechnology.

H4b. Technology readiness will have a positive effect on an individual's attitudes towards fall detection gerontechnology.

H5a. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall detection gerontechnology.

H6b. Sources of information will be correlated to an individual's attitudes towards fall detection gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.919. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in attitudes towards fall detection gerontechnology predicted by perceived knowledge on fall detection gerontechnology, technology readiness, interior design aesthetics, and sources of information, $F(4,310) = 6.933$, $p = 0.000$. Multiple R squared indicates that approximately 8% of the variation in attitudes towards fall detection gerontechnology was predicted by the group of independent variables. According to Cohen (1988), this suggests a small to medium effect. The results of regression analysis showed two significant variables ($p<0.05$). The variables were technology readiness ($\beta = 0.202$) and sources of information ($\beta = 0.151$) (see Table 24). Standardized coefficients showed that technology readiness had the biggest impact on attitudes towards fall detection gerontechnology among other variables. The direct effect of these variables on attitudes towards fall detection gerontechnology is shown in Figure 12 (after path analysis test).

Table 24

Fall Detection Gerontechnology – Path Analysis Result: Coefficients of Path Model 2

Model 2	**β**	**t-value**	***p***
Perceived Knowledge on Fall Detection Gerontechnology	-.098	-1.783	.76
Technology Readiness	.202	3.548*	.00
Interior Design	-.048	-.869	.38
Sources of Information	.151	2.648*	.00
R^2	.08		
F change	6.93		

Note. Dependent Variable: Attitudes Towards Fall Detection Gerontechnology
*p<.05

With the results from the analysis of Model 2, two of the hypotheses tested were supported (hypotheses 4b, and 6b). In other words, technology readiness (independent variable) predicted attitudes towards fall detection gerontechnology (dependent variable). In addition, sources of information appeared to be correlated to the dependent variable.

After testing Model 2, a series of simple linear regression analyses were conducted to determine if any of the independent variables that appeared to be not significant on Model 2 would be statistically significant when not controlling for other predictors. Results from the analyses suggested that none of the independent variables were statistically significant on predicting attitudes towards fall detection gerontechnology.

The third multiple regression model tested the relationships of perceived knowledge on fall detection gerontechnology, desire to age-in-place (independent variables) and attitudes towards benefits of fall detection gerontechnology (dependent variable). This model tested the following hypotheses:

H1b. Perceived knowledge on fall detection gerontechnology will have a positive effect on attitudes towards benefits of fall detection gerontechnology.

H3b. Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall detection gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.990. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the two independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is not a significant proportion of the total variation in attitudes towards benefits of fall detection gerontechnology predicted by perceived knowledge on fall detection gerontechnology and desire to age-in-place, $F(2,311) = 1.321$, $p = 0.268$. The results of regression analysis did not show any significant variables ($p<0.05$). Table 25 presents the result of multiple regression analysis.

Table 25

Fall Detection Gerontechnology – Path Analysis Result: Coefficients of Path Model 3

Model 3	**β**	**t-value**	***p***
Perceived Knowledge on Fall Detection Gerontechnology	-.03	-.52	.60
Desire to age-in-place	.08	1.54	.12
R^2	.00		
F change	1.32		

Note. Dependent Variable: Attitudes Towards Benefits of Fall Detection Gerontechnology

With the results from the analysis of Model 3, none of the hypotheses tested were supported. In other words, perceived knowledge on fall prevention gerontechnology and desire to age-in-place (independent variables) did not predict attitudes towards benefits of fall detection gerontechnology (dependent variable).

After testing Model 3, two simple linear regression analyses were conducted to determine if any of the independent variables would be statistically significant when not controlling for other predictors. Results from the analyses suggested that none of the independent variables were statistically significant on predicting attitudes towards benefits of fall detection gerontechnology.

The fourth multiple regression model tested the relationships of attitudes towards fall detection gerontechnology, attitudes towards benefits of fall detection gerontechnology, interior design aesthetics of older adults' home environment, sources of information (independent variables) and purchase intention of fall detection gerontechnology (dependent variable). This model tested the following hypotheses:

H2a. Attitudes towards fall detection gerontechnology will have a positive effect on purchase intention of fall detection gerontechnology.

H2b. Attitudes towards benefits of fall detection gerontechnology will have a positive effect on purchase intention of fall detection gerontechnology.

H5b. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall detection gerontechnology.

H6c. Sources of information will be correlated to an individual's purchase intention of fall detection gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 2.144. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in purchase intention of fall detection gerontechnology predicted by attitudes towards fall detection gerontechnology, attitudes towards benefits of fall detection gerontechnology, interior design aesthetics, and sources of information, $F(4,309) = 19.881$, $p = 0.000$. Multiple R squared indicates that approximately 20% of the variation in purchase intention of fall detection gerontechnology was predicted by the group of independent variables. According to Cohen (1988), this suggests a medium to large effect. The results of regression analysis showed three significant variables ($p<0.05$). The variables were attitudes towards fall detection gerontechnology ($\beta = 0.304$), attitudes towards benefits of fall detection gerontechnology ($\beta = 0.167$), and interior design ($\beta = -0.119$). The direct effect of these variables on purchase intention of fall detection gerontechnology is shown in Figure 12 (after path analysis test). Table 26 presents the result of multiple regression analysis.

Table 26

Fall Detection Gerontechnology – Path Analysis Result: Coefficients of Path Model 4

Model 4	**β**	**t-value**	***p***
Attitudes Towards Fall Detection Gerontechnology	.30	4.94*	.00
Attitudes Towards Benefits of Fall Detection Gerontechnology	.16	2.75	.00
Sources of Information	.07	1.41	.15
Interior Design	-.11	-2.31*	.02
R^2	.20		
F change	19.88		

Note. Dependent Variable: Purchase Intention of Fall Detection Gerontechnology
*p<.05

With the results from the analysis of Model 4, two of the hypotheses tested were supported (hypotheses 2a, and 5b). In other words, attitudes towards fall detection gerontechnology and interior design, (independent variables) predicted purchase intention of fall detection gerontechnology (dependent variable).

After testing Model 4, two simple linear regressions were conducted to identify if any of the independent variables that were not statistically significant in the model would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that sources of information was correlated with purchase intention of fall detection gerontechnology when not controlling for the other predictors as reported below.

A simple linear regression analysis was conducted to determine if purchase intention of fall detection gerontechnology was correlated to sources of information. The results of the simple linear regression suggest that a significant proportion of the total variation in purchase intention of fall detection gerontechnology was correlated to sources of information, $F(1, 313) = 5.946$, $p = .015$. Additionally, the unstandardized slope (.220) and standardized slope (.137) are statistically significantly different from 0 ($t = 2.438$, $df = 313$, $p = .015$), and the intercept (or average purchase intention of fall detection gerontechnology score when sources of information is 0) was 1.624. Multiple R squared indicates that approximately 1% of the variation in purchase intention of fall detection gerontechnology was predicted by sources of information. According to Cohen (1988), this suggests a small effect.

Figure 12 presents the significant relationships from path analysis. The relationships statistically significant in the multiple regression model tests were reported. A summary of the hypotheses tests is presented on Table 27.

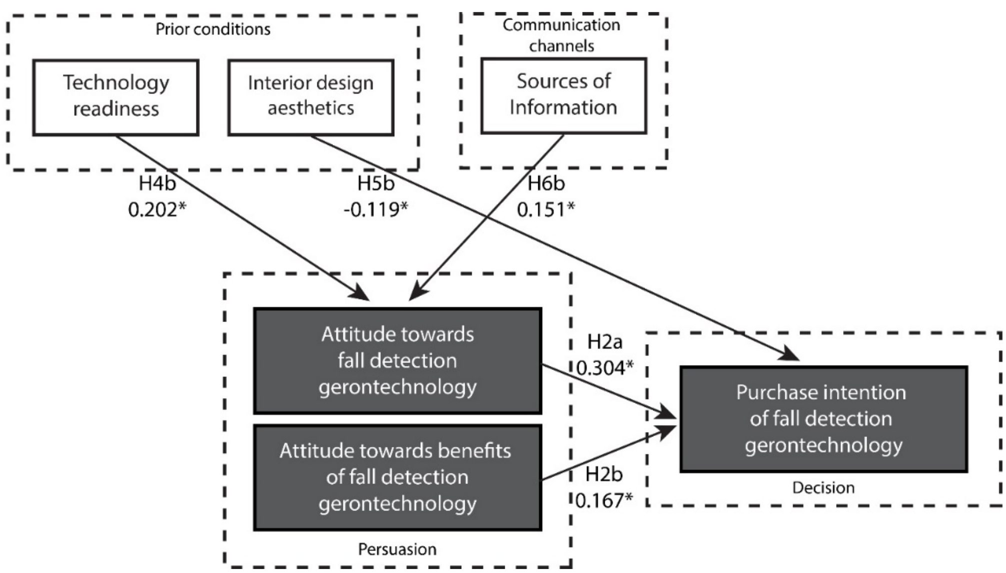

Figure 12. Fall detection gerontechnology: Significant paths from regression analysis. Note: $*p<0.05$.

Table 27

Fall Detection: Summary of Results from Hypotheses Tests

	Hypotheses	Multiple Regression	Simple Linear Regression
H1a	Perceived knowledge on fall detection gerontechnology will have a positive effect on attitudes towards fall detection gerontechnology.	Not Supported	Not Supported
H1b	Perceived knowledge on fall detection gerontechnology will have a positive effect on attitudes towards benefits of fall detection gerontechnology.	Not Supported	Not Supported
H2a	Attitudes towards fall detection gerontechnology will have a positive effect on purchase intention of fall detection gerontechnology.	**Supported**	**Supported**
H2b	Attitudes towards benefits of fall detection gerontechnology will have a positive effect on purchase intention of fall detection gerontechnology.	**Supported**	**Supported**
H3a	Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall detection gerontechnology.	Not Supported	Not Supported
H3b	Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall detection gerontechnology.	Not Supported	Not Supported
H4a	Technology readiness will have a positive effect on an individual's perceived knowledge on fall detection gerontechnology.	Not Supported	Not Supported
H4b	Technology readiness will have a positive effect on an individual's attitudes towards fall detection gerontechnology.	**Supported**	**Supported**
H5a	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall detection gerontechnology.	Not Supported	Not Supported
H5b	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall detection gerontechnology.	**Supported**	**Supported**
H6a	Sources of information will be correlated to an individual's perceived knowledge on fall detection gerontechnology.	Not Supported	Not Supported
H6b	Sources of information will be correlated to an individual's attitudes towards fall detection gerontechnology.	**Supported**	**Supported**
H6c	Sources of information will be correlated to an individual's purchase intention of fall detection gerontechnology.	Not Supported	**Supported**
H7	A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall detection gerontechnology.	Not Supported	Not Supported
H8	Fear of falling will have a positive effect on perceived knowledge on fall detection gerontechnology.	Not Supported	Not Supported

Fall Monitoring Gerontechnology

In order to explore relationships proposed in the operational model for the decision-process of fall monitoring gerontechnology (Figure 8), four multiple regression analyses were employed.

The first multiple regression model tested the relationships of desire to age-in-place, technology readiness, sources of information, aging attitudes, fear of falling (independent variables) and perceived knowledge on fall monitoring gerontechnology (dependent variable). This model tested the following hypotheses:

H3a. Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall monitoring gerontechnology.

H4a. Technology readiness will have a positive effect on an individual's perceived knowledge on fall monitoring gerontechnology.

H6a. Sources of information will be correlated to an individual's perceived knowledge on fall monitoring gerontechnology.

H7. A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall monitoring gerontechnology.

H8. Fear of falling will have a positive effect on perceived knowledge on fall monitoring gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.917. The Durbin-Watson statistic should be

as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the five independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is not a significant proportion of the total variation in perceived knowledge on fall monitoring gerontechnology predicted by desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling, $F(5,310) = 1.661$, $p = 0.144$. The results of regression analysis did not show any significant variables ($p<0.05$). Table 28 presents the result of multiple regression analysis.

Table 28

Fall Monitoring Gerontechnology – Path Analysis Result: Coefficients of Path Model 1

Model 1	**β**	**t-value**	***p***
Desire to age-in-place	.04	.71	.47
Technology Readiness	.09	1.63	.10
Sources of Information	.09	1.62	.10
Aging Attitudes	-.02	-.46	.64
Fear of Falling	.01	.28	.77
R^2	.02		
F change	1.66		

Note. Dependent Variable: Perceived Knowledge on Fall Monitoring Gerontechnology

With the results from the analysis of Model 1, none of the hypotheses tested were supported. In other words, desire to age-in-place, technology readiness, sources of information, attitudes towards aging, and fear of falling (independent variables) did not predict perceived knowledge on fall monitoring gerontechnology (dependent variable).

After testing Model 1, a series of simple linear regressions were conducted to identify if any of the independent variables would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that sources of information was statistically significant correlating to perceived knowledge on fall monitoring gerontechnology when not controlling for the other predictors as reported below.

A simple linear regression analysis was conducted to determine if perceived knowledge on fall monitoring gerontechnology was correlated to sources of information. The results of the simple linear regression suggest that a significant proportion of the total variation in perceived knowledge on fall monitoring gerontechnology was correlated to sources of information, $F(1, 315) = 5.46$, $p = .02$. Additionally, the unstandardized slope (.152) and standardized slope (.131) are statistically significantly different from 0 ($t = 2.336$, $df = 315$, $p = .02$), and the intercept (or average perceived knowledge on fall monitoring gerontechnology score when sources of information is 0) was 1.933. Multiple R squared indicates that approximately 1% of the variation in perceived knowledge on fall monitoring gerontechnology was predicted by sources of information. According to Cohen (1988), this suggests a small effect.

The second multiple regression model tested the relationships of perceived knowledge on fall monitoring gerontechnology, technology readiness, interior design aesthetics, sources of information (independent variables) and attitudes towards fall monitoring gerontechnology (dependent variable). This model tested the following hypotheses:

H1a. Perceived knowledge on fall monitoring gerontechnology will have a positive effect on attitudes towards fall monitoring gerontechnology.

H4b. Technology readiness will have a positive effect on an individual's attitudes towards fall monitoring gerontechnology.

H5a. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall monitoring gerontechnology.

H6b. Sources of information will be correlated to an individual's attitudes towards fall monitoring gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.779. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in attitudes towards fall monitoring gerontechnology predicted by perceived knowledge on fall monitoring gerontechnology, technology readiness, interior design aesthetics, and sources of information, $F(4,310) = 6.545$, $p = 0.000$. Multiple R squared indicates that approximately 8% of the variation in attitudes towards fall monitoring gerontechnology was predicted by the group pf independent variables. According to Cohen (1988), this suggests a small to medium effect. The results of regression analysis showed two significant variables ($p<0.05$). The variables were technology readiness ($\beta = 0.167$) and sources of information ($\beta = 0.178$) (see Table 29). The direct effect of these variables on attitudes towards fall monitoring gerontechnology is shown in Figure 13 (after path analysis test).

Table 29

Fall Monitoring Gerontechnology – Path Analysis Result: Coefficients of Path Model 2

Model 2	**β**	**t-value**	***p***
Perceived Knowledge on Fall Monitoring Gerontechnology	.02	0.36	0.71
Technology Readiness	.16	2.91*	0.00
Interior Design	-.06	-1.17	0.24
Sources of Information	.17	3.10*	0.00
R^2	.07		
F change	6.54		

Note. Dependent Variable: Attitudes Towards Fall Monitoring Gerontechnology
*p<.05

With the results from the analysis of Model 2, two of the hypotheses tested were supported (hypotheses 4b, and 6b). In other words, technology readiness (independent variable) predicted attitudes towards fall monitoring gerontechnology (dependent variable). In addition, sources of information appeared to be correlated to the dependent variable.

After testing Model 2, two simple linear regression analyses were conducted to determine if any of the independent variables that were not statistically significant in the model would be significant when not controlling for other predictors. Results from the analyses suggested that none of the independent variables were statistically significant on predicting attitudes towards fall monitoring gerontechnology.

The third multiple regression model tested the relationships of perceived knowledge on fall monitoring gerontechnology, desire to age-in-place (independent variables) and attitudes towards benefits of fall monitoring gerontechnology (dependent variable). This model tested the following hypotheses:

H1b. Perceived knowledge on fall monitoring gerontechnology will have a positive effect on attitudes towards benefits of fall monitoring gerontechnology.

H3b. Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall monitoring gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.801. The Durbin-Watson statistic should be as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the two independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is not a significant proportion of the total variation in attitudes towards benefits of fall monitoring gerontechnology predicted by perceived knowledge on fall monitoring gerontechnology and desire to age-in-place, $F(2,313) = 2.051$, $p = 0.130$. Despite the multiple regression model was not significant, there was one significant interaction ($p<0.05$), which is the interaction between perceived knowledge on fall monitoring and attitudes towards benefits of fall monitoring gerontechnology, $t(313) = 2.023$, $p = 0.044$. Table 30 presents the result of multiple regression analysis.

Table 30

Fall Monitoring Gerontechnology – Path Analysis Result: Coefficients of Path Model 3

Model 3	**β**	**t-value**	***p***
Perceived Knowledge on Fall Monitoring Gerontechnology	.11	2.02*	0.04
Desire to age-in-place	.00	0.00	0.99
R^2	.01		
F change	2.05		

Note. Dependent Variable: Attitudes Towards Benefits of Fall Monitoring Gerontechnology
*p<.05

With the results from the analysis of Model 3, one of the hypotheses tested was supported (hypothesis 1b). In other words, perceived knowledge on fall monitoring gerontechnology (independent variable) predicted attitudes towards benefits of fall monitoring gerontechnology (dependent variables).

After testing Model 3, a simple linear regression analysis was conducted to determine if desire to age-in-place would be significant when not controlling for perceived knowledge on fall monitoring gerontechnology. Results from the analysis suggested that desire to age-in-place was not statistically significant on predicting attitudes towards benefits of fall monitoring gerontechnology.

The fourth multiple regression model tested the relationships of attitudes towards fall monitoring gerontechnology, attitudes towards benefits of fall monitoring gerontechnology, interior design aesthetics of older adults' home environment, sources of information (independent variables) and purchase intention of fall monitoring gerontechnology (dependent variable). This model tested the following hypotheses:

H2a. Attitudes towards fall monitoring gerontechnology will have a positive effect on purchase intention of fall monitoring gerontechnology.

H2b. Attitudes towards benefits of fall monitoring gerontechnology will have a positive effect on purchase intention of fall monitoring gerontechnology.

H5b. Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall monitoring gerontechnology.

H6c. Sources of information will be correlated to an individual's purchase intention of fall monitoring gerontechnology.

Prior to the multiple regression analysis, the following six assumptions were analyzed: independence of errors, linearity of the relationship between the dependent and independent variables, homoscedasticity, multicollinearity, normality of errors distributions, and significant outliers or influential points. All six assumptions were met. The independence of errors assumption was met with a Durbin-Watson score of 1.966. The Durbin-Watson statistic should be

as close as 2 as possible (with a safe range between 1.5 and 2.5) to indicate that there is no correlation between residuals. Review of partial scatterplots of the four independent variables and the dependent variable indicates linearity is a reasonable assumption. Additionally, the plot of residuals against the predicted variable indicates there is a random distribution of positive and negative values, provided further evidence of linearity. The assumption of homoscedasticity was assessed using the same scatterplot. Because there is no pattern shown in the scatterplot, this assumption is met. The assumption of multicollinearity was assessed using Pearson's correlation coefficient. No multicollinearity was found as no correlations were above 0.70. In addition, all of the tolerances were greater than 0.10 and the variance inflation factor were less than 10. The Q-Q plot and histogram suggested normality was reasonable. Examination of casewise diagnostics, including Mahalanobis distance, Cook's distance, DfBeta values, and centered leverage values, suggested there were no cases exerting undue influence on the model.

The results of the multiple linear regression suggest that there is a significant proportion of the total variation in purchase intention of fall monitoring gerontechnology predicted by attitudes towards fall monitoring gerontechnology, attitudes towards benefits of fall monitoring gerontechnology, interior design aesthetics, and sources of information, $F(4,309) = 22.152$, $p = 0.000$. Multiple R squared indicates that approximately 22% of the variation in purchase intention of fall monitoring gerontechnology was predicted by the group of independent variables. According to Cohen (1988), this suggests a large effect. The results of regression analysis showed two significant variables ($p<0.05$). The variables were attitudes towards fall monitoring gerontechnology ($\beta = 0.238$) and attitudes towards benefits of fall monitoring gerontechnology ($\beta = 0.255$) (see Table 31). Standardized coefficients showed that attitudes towards benefits of fall monitoring gerontechnology had the biggest impact on purchase intention of fall monitoring gerontechnology among other variables. The direct effect of these variables on purchase intention of fall detection gerontechnology is shown in Figure 13.

Table 31

Fall Monitoring Gerontechnology – Path Analysis Result: Coefficients of Path Model 4

Model 4	**β**	**t-value**	***p***
Attitudes Towards Fall Monitoring Gerontechnology	.23	3.77*	.00
Attitudes Towards Benefits of Fall Monitoring Gerontechnology	.25	4.06*	.00
Sources of Information	.09	1.80	.07
Interior Design	-.04	-.97	.33
R^2	.22		
F change	22.15		

Note. Dependent Variable: Purchase Intention of Fall Monitoring Gerontechnology
*p<.05

With the results from the analysis of Model 4, two of the hypotheses tested were supported (hypotheses 2a, and 2b). In other words, attitudes towards fall monitoring gerontechnology and attitudes towards benefits of fall monitoring gerontechnology (independent variables) predicted purchase intention of fall monitoring gerontechnology (dependent variable).

After testing Model 4, two simple linear regressions were conducted to identify if any of the independent variables that were not statistically significant in the model would have a significant relationship with the dependent variable when not controlling for other predictors. Results from the analyses suggested that sources of information was statistically correlated to purchase intention of fall monitoring gerontechnology when not controlling for the other predictors as reported below.

A simple linear regression analysis was conducted to determine if purchase intention of fall monitoring gerontechnology was correlated to sources of information. The results of the simple linear regression suggest that a significant proportion of the total variation in purchase intention of fall monitoring gerontechnology was correlated to sources of information, $F(1, 313) = 12.328$, $p = .001$. Additionally, the unstandardized slope (.310) and standardized slope (.195) are statistically significantly different from 0 ($t = 3.511$, $df = 313$, $p = .001$), and the intercept (or average purchase intention of fall monitoring gerontechnology score when sources of information is 0) was 1.244. Multiple R squared indicates that approximately 3% of the variation in purchase intention of fall monitoring gerontechnology was predicted by sources of information. According to Cohen (1988), this suggests a small effect. Figure 20 presents the significant relationships from path analysis. The relationships statistically significant in the multiple regression model tests were reported.

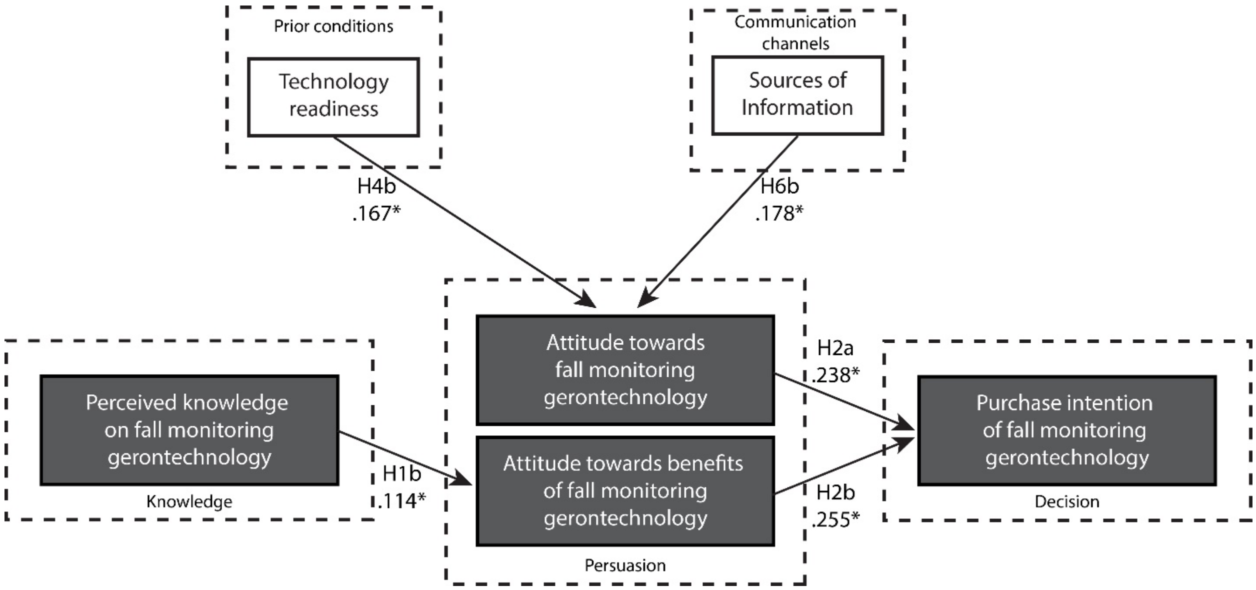

Figure 13. Fall monitoring gerontechnology: significant paths from regression analysis. Note: **p*<0.05.

After testing direct effects, as the main path had at least one significant direct effect connecting the three stages, a test of indirect and total effect was performed. Multiple regression analyses were conducted to assess each component of the proposed mediation model (Figure 14). First, it was found that perceived knowledge on fall monitoring gerontechnology was positively associated with purchase intention of fall monitoring gerontechnology (b = .25, t (306) = 3.254, p = .001). It was also found that perceived knowledge on fall monitoring gerontechnology was positively related to attitudes towards benefits of fall monitoring gerontechnology (b = .172, t (306) = 2.455, p = .01). Lastly, results indicated that the mediator, attitudes towards benefits of fall monitoring gerontechnology, was positively associated with purchase intention of fall monitoring gerontechnology (b = .458, t (305) = 8.11, p = .000). Because both the a-path and b-path were significant, mediation analyses were tested using the bootstrapping method with bias-corrected confidence estimates (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004). In the present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap resamples (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating role of attitudes towards benefits of fall monitoring gerontechnology in the relation between perceived knowledge on fall monitoring gerontechnology and purchase intention of fall monitoring gerontechnology (b = .078; CI = .008 to .15). In addition, results indicated that the direct effect of perceived knowledge on fall monitoring gerontechnology on purchase intention of fall monitoring gerontechnology was significant, but lessened (b = .172, t (305) = 2.43, p = .01) when controlling for attitudes towards benefits of fall monitoring gerontechnology, thus suggesting partial mediation. Results are summarized on Table 32. A summary of the hypotheses tests is presented on Table 33.

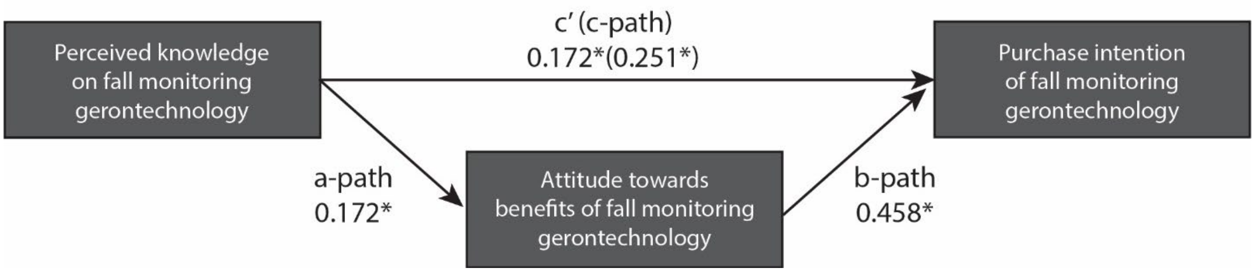

Figure 14. Fall monitoring gerontechnology: indirect effect and total effects of perceived knowledge on purchase intention through attitudes towards benefits of gerontechnology. Note: *p<0.05.

Table 32

Fall monitoring Gerontechnology: Mediation Analysis

	b	***t***	***p***
Mediation a-path	.172	2.442	.01
Mediation b-path	.458	8.109	.00
Total effect c-path	.251	3.254	.00
Direct effect c'-path	.172	2.435	.01
Indirect effect a-path x b-path (with bootstrapped 95% confidence interval)	.078 [.01, 0.15]		

Table 33

Fall Monitoring: Summary of Results from Hypotheses Tests

	Hypotheses	Multiple Regression	Simple Linear Regression
H1a	Perceived knowledge on fall monitoring gerontechnology will have a positive effect on attitudes towards fall monitoring gerontechnology.	Not Supported	Not Supported
H1b	Perceived knowledge on fall monitoring gerontechnology will have a positive effect on attitudes towards benefits of fall monitoring gerontechnology.	**Supported**	**Supported**
H2a	Attitudes towards fall monitoring gerontechnology will have a positive effect on purchase intention of fall monitoring gerontechnology.	**Supported**	**Supported**
H2b	Attitudes towards benefits of fall monitoring gerontechnology will have a positive effect on purchase intention of fall monitoring gerontechnology.	**Supported**	**Supported**
H3a	Desire to age-in-place will have a positive effect on an individual's perceived knowledge about fall monitoring gerontechnology.	Not Supported	Not Supported
H3b	Desire to age-in-place will have a positive effect on an individual's attitudes towards benefits of fall monitoring gerontechnology.	Not Supported	Not Supported
H4a	Technology readiness will have a positive effect on an individual's perceived knowledge on fall monitoring gerontechnology.	Not Supported	Not Supported
H4b	Technology readiness will have a positive effect on an individual's attitudes towards fall monitoring gerontechnology.	**Supported**	**Supported**
H5a	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's attitudes towards fall monitoring gerontechnology.	Not Supported	Not Supported
H5b	Interior design aesthetics of older adults' home environment will have a positive effect on an individual's purchase intention of fall monitoring gerontechnology.	Not Supported	Not Supported
H6a	Sources of information will be correlated to an individual's perceived knowledge on fall monitoring gerontechnology.	Not Supported	**Supported**
H6b	Sources of information will be correlated to an individual's attitudes towards fall monitoring gerontechnology.	**Supported**	**Supported**
H6c	Sources of information will be correlated to an individual's purchase intention of fall monitoring gerontechnology.	Not Supported	**Supported**
H7	A positive aging attitude will have a positive effect on an individual's perceived knowledge on fall monitoring gerontechnology.	Not Supported	Not Supported
H8	Fear of falling will have a positive effect on perceived knowledge on fall monitoring gerontechnology.	Not Supported	Not Supported

CHAPTER V

DISCUSSION

This chapter provides an interpretative discussion of the research findings. The purpose of this study was to examine the diffusion of technology related to fall prevention, detection, and monitoring among older adults for aging-in-place based on the five stages of the Diffusion Innovation Theory. A research model based on the first three stages of the innovation-decision process – knowledge, persuasion, and decision – was developed and tested to understand connections between the variables. Path analysis through multiple regression was used to test the model.

Knowledge Stage to Persuasion Stage

According to Rogers (2003), knowledge leads to persuasion, or to consumers' attitudes towards the innovation. Thus, a person needs to have some understanding about an innovation before they begin to form an opinion about it. In addition, perceived knowledge has bigger impact on persuasion than factual knowledge. Research has shown that attitudes towards an innovation are better predicted when they are associated with high levels of perceived knowledge (Chen & Deng, 2016; Fabrigar et al., 2006; Michalos et al., 2009; Tormala & Petty, 2007; Su et al., 2014).

Based on this notion, it was hypothesized that perceived knowledge would have a positive effect on (a) attitudes towards fall-related gerontechnology, and (b) attitudes towards benefits of fall-related gerontechnology. In this study, older adults' beliefs that gerontechnology could help them to age-in-place was considered as benefits of fall-related gerontechnology.

These hypotheses were supported for fall prevention gerontechnology, but were not supported for fall detection and they were partially supported for fall monitoring gerontechnology. By partially supported, I mean that it was not supported when asked about older adults' general attitudes towards fall monitoring gerontechnology, but it was supported when asked about benefits of aging-in-place. This means that even with high levels of perceived knowledge about fall monitoring gerontechnology, it does not affect older adults' general opinions (like, dislike), but it affects their perceptions that fall monitoring gerontechnology could promote aging-in-place.

We can try to understand the reasons behind participants' responses when looking into the devices that were presented to them during the survey. In both information sheets about fall prevention and fall monitoring gerontechnologies, at least one device in each of these categories has been in available the market (i.e. a motion sensor and a monitoring device, both using well-known infrared sensor technology), therefore possible more familiar to the participants. On the other hand, both devices presented in the fall detection category are cutting edge devices (a floor sensor that can be installed under any type of flooring and a robot), therefore possible not familiar to them.

In addition, looking into the descriptive responses about perceived knowledge, attitudes towards, and attitudes towards benefits of fall-related gerontechnology, we can see a large number of neutral response, which could mean that participants in this study may not have a strong opinion about these types of technology and need more information about them before developing an opinion and being able to move into the next step of the innovation-decision process.

Persuasion Stage to Decision Stage

According to Rogers (2003), "persuasion occurs when an individual (. . .) forms a favorable or unfavorable attitude towards innovation" (p. 169). During the persuasion stage, a person continues gathering information and building their knowledge about the innovation. However, while at the knowledge stage this information influences a person cognitively, at the persuasion stage the information have sensitive outcomes, affecting consumers' feelings (Bouwhuis, 2017; Rogers, 2003). If older adults have positive attitudes towards fall prevention, fall detection, and fall monitoring gerontechnologies, it is expected that they will be inclined to purchase the innovation (Rogers, 2003). For these reasons, it was hypothesized that (a) attitudes towards fall-related gerontechnology, and (b) attitude towards benefits of fall-related gerontechnology will have a positive effect on purchase intention of fall-related gerontechnology.

In this study, these hypotheses were supported throughout all three fall prevention, fall detection, and fall monitoring gerontechnologies. This means that if older adults get to form an opinion during the persuasion stage, they will carry it to the decision stage. In other words, if an older adult develops a positive attitude towards a fall-related gerontechnology, they will be inclined to purchase it. On the other hand, if they build a negative attitude towards a fall-related technology, they will most likely decline to purchase the device.

When looking independently into attitudes towards benefits of fall prevention gerontechnology affecting its purchase intention, in the model test using multiple regression, it did not appear significant. However, the simple linear regression showed that there is a significant relationship between the variables, therefore suggesting that perhaps with a larger sample or by adding other variables into the model, attitudes towards benefits of fall prevention gerontechnology could become significant in the model test when predicting purchase intention of fall prevention gerontechnology.

Desire to Age-in-Place to Knowledge and Persuasion Stages

In this study, desire to age-in-place was considered a prior condition that would likely influence both knowledge and attitudes towards benefits of fall-related gerontechnology, especially because benefits in this case is the benefit of promoting aging-in-place. Rogers (2003) considered prior conditions as the circumstances that stimulate the beginning of the innovation-decision process. In the five stages of the innovation-decision process from Rogers (2003), the prior conditions appear before the knowledge stage, indicating that these conditions come before any knowledge on the innovation. However, other scholars have argued that individuals will not learn about an innovative product or service unless they initially see its advantage based on some prior conditions (Dobbins et al., 2002; Friestad & Wright, 1994; Leonard-Barton & Deschamps, 1988).

The results in this study were that about 83% of participants were willing to age-in-place in their own residences, therefore, preferentially not moving to an assisted living facility or a nursing home. This is in accordance to previous literature that state that most older adults prefer to age-in-place (Lau et al., 2007; Oswald et al., 2010; Paganini-Hill, 2013; Wiles et al., 2011). But even though most participants stated not being knowledgeable about fall-related gerontechnology, this was not enough to have a relationship between desire-to age in-place and knowledge on fall-related gerontechnology. In the same way, not a significant connection was found between participants' strong desire to age-in-place and positive or negative attitudes towards benefits of fall related gerontechnology, therefore suggesting that it is not because a large number of participants want to age-in-place that they would necessarily believe that fall-related gerontechnology is the best way to achieve that goal. Hence, this assumption was not supported in all hypotheses tests.

Technology Readiness to Knowledge and Persuasion Stages

In this study, technology readiness is considered people's propensity to embrace and use new technologies for accomplishing personal goals (Parasuraman, 2000). Technology readiness was also considered a prior condition for the innovation-decision process, affecting knowledge and attitudes towards fall-related gerontechnology. In terms of fall prevention gerontechnology, both hypotheses 4a and 4b were not statistically significant in the multiple regression analysis, but they were significant in simple regression analysis, indicating that there is a significant correlation among variables. In terms of fall detection and fall monitoring gerontechnologies, technology readiness was not a statistically significant predictor of perceived knowledge. However, it was a significant predictor of attitudes towards fall detection and fall monitoring gerontechnologies, indicating that the more an older adult is open to embrace new technologies, the more they will have a positive attitude towards fall detection and fall monitoring gerontechnologies.

Different generations have different relationship with technological devices. The population of this study is from baby boomer generation (born between 1946 and 1964) and silent generation (born between 1925 and 1945). Both of these generations have a different relationship with technology than people who will be considered older adults in the future decades. Previous research shows that even though there are difference on gerontechnology acceptance between people from the silent generation and baby boomers (baby boomers having a higher acceptance rate of gerontechnology), this difference is not higher enough to be statistically significant (Mihailidis et al., 2008). The reason behind this may be simple as when high-tech personal devices (i.e. personal computers, mobile phones, and later on, Internet) started being widely spread among population in the decade if 1980 and 1990, the youngest baby boomer were already adults. On the other hand, the future generation of older adults was born in the high-tech era, where they are used to deal with technology since their first year of age. Therefore, it is expected that the relationship between technology and older adults will likely have a stronger difference when people from Generation X (born between 1965 and 1979), Y (born between 1980 and 1994), and Z (born between 1995 and 2012) grow older, largely increasing gerontechnology acceptance rate among older adults.

Interior Design Aesthetics to Persuasion and Decision Stages

Interior design aesthetics was also tested as a prior condition of the innovation-decision process, affecting attitudes towards and purchase intention of fall-related gerontechnology. This variable appeared to be significant only as a predictor for purchase intention of fall detection gerontechnology. It is interesting to notice that it was hypothesized that Interior design aesthetics appeal of older adults' home environment will have a positive effect on an individual's (a) attitude towards, and (b) purchase intention of fall-related gerontechnology, however, the relationship that appeared significant was a negative correlation. In other words, the lower the interior design aesthetics of a house, the more they intentionally would purchase a fall detection gerontechnology.

The reasons behind it could vary. First, it was identified that older adults perceived interior design aesthetics decrease with advanced age. This could mean that older people that would be more worried about the possibility of aging-in-place, would also be willing to purchase fall detection gerontechnology. Second, this could also mean that the one device present in the information sheet that talked about interior design was a fall detection gerontechnology. The devise was a floor sensor that is placed under any type of flooring, therefore, not affecting the interior design. In the descriptive analysis, around 76% of the participants had good impressions about the interior design of their residences.

Sources of Information to Knowledge, Persuasion, and Decision Stages

Most participants stated that they learn about new technologies from their family and friends (interpersonal channels), followed by TV (mass media), Internet (hybrid of interpersonal and mass media), newspaper (mass media), and radio (mass media). Rogers (2003) generalized that "mass media channels are relatively more important at the knowledge stage, and interpersonal channels are more important at the persuasion stage in the innovation-decision process" (p. 205).

In this study, sources of information were not correlated to perceived knowledge on any of the multiple regression analysis of fall prevention, detection and monitoring gerontechnologies. However, it appeared significant in the simple regression analysis predicting perceived knowledge on fall prevention and fall monitoring gerontechnologies. In the information sheet, at least one of the devices presented in each section are already in the market. This shows that there is a correlation between sources of information and perceived knowledge. The use of Internet through personal devices was stated by 42% of the participants as a good way of learning about newly introduced gerontechnology. However, it is possible that the future generations of older adults will be more likely to learn about gerontechnology that promote aging-in-place through Internet.

With regards to sources of information affecting attitudes towards fall prevention, fall detection, and fall monitoring gerontechnology, all the tests were statistically significant. It reinforces Rogers's (2003) generalization that interpersonal channels affect more persuasion than knowledge, which could mean that older adults family members, especially their children have an important impact on older adults' opinions and choices on the type of technological devices they would be persuaded to purchase. This assumption is in accordance to the fact that all correlation tests appeared significant between sources of information and purchase intention. As the participants in this study reported that family and friends are the ones who influence them the most about new technologies, perhaps it is too early to expect that older adults' children and even earlier to expect that older adults' friends, likely on their same age, would have some strong influence on older adults' decision process of fall-related gerontechnology, as this type of gerontechnology is in the very early diffusion stages.

Attitudes Towards Aging to Knowledge Stage

Attitudes towards aging are relevant in order to understand how older adults face the changes and challenges inherent to the aging process and how it influences their knowledge about fall-related gerontechnology (Pang et al., 2016; Shenkin et al., 2014; Zhang et al., 2015). Rogers (2003) said that people who deal better with changes in life have better attitudes towards innovation. On the other hand, if older adults do not feel experiencing much of a change in their aging process, that could cause indifference towards innovation. Accordingly, the following is hypothesized that a positive aging attitude will have a positive effect on an individual's perceived knowledge on fall-related gerontechnology.

Attitudes towards aging were not significant as a predictor for perceived knowledge on any of the three fall-related gerontechnology. This may be explained by the fact that about 83% of the participants had positive attitudes towards aging, but it did not lead to higher or lower levels of perceived knowledge among the participants. The high levels of attitudes towards aging could have at least two explanations: the first one is that participants in this study do not feel that they had experienced enough change in their lives due to the aging process that would affect them negatively. One fact that could support this explanation is that around 80% of the participants rated their health status as good or excellent.

Another reason could be that they simply face well the changes they are experiencing, even in case of negative changes. However, going deeper in trying to understand participant's patterns on attitudes towards aging, this component was divided into three factors: psychosocial loss, that is the psychological and social factors that influence mental health, for example, facing depression or loneliness; physical change, that is the changes that happen in their bodies, like a decrease of motor skills or muscular strength; and psychological growth, which is related to feeling wiser and privileged for growing older. Among all three, physical change was the one that was lower rated, but still was positively rated by 65% of participants.

Fear of Falling to Knowledge Stage

In this study, fear of falling was hypothesized as being a predictor for knowledge on fall-related gerontechnology. Fear of falling often occurs after an individual has had a fall episode, especially if the recovering time was long and difficult (Patel et al., 2014; Tideiksaar, 2003). The effects of fear of falling are usually very damaging and hard to overcome. Fear of falling in older adults may be responsible for restriction of mobility and activities, particularly those that happen outside home (Denkinger et al., 2015; Patel et al., 2014; Tideiksaar, 2003). When older adults confine themselves to the home environment, their body muscles tend to get weaken due to disuse, triggering the falls inside the home environment, resulting in loss of independence and depression (Denkinger et al., 2015; Tideiksaar, 2003; Young & Williams, 2015). Older adults facing fear of falling and losing independence because of it may be more inclined to learn about technological devices that can help them to overcome the problem. Rogers (2003) says that "a need is a state of dissatisfaction or frustration that occurs when an individual's desires outweigh the individual's actualities" (p.172). A need to overcome fear of falling could be responsible to start the innovation-decision process towards fall-related gerontechnology.

In this study, 73% of participants have no fear of very little concern about falling in their home environment. In addition, about 71% did not report any fall in their home environment in the last three years. Among those who reported a fall, very few were hospitalized due to a fall. These results may explain the reasons for low fear of falling among the participants. Also, even though most participants reported low levels of perceived knowledge on all three fall-related gerontechnologies, it was not low enough to make any significant correlation among variables. Perhaps if most participants have had a fall and had been hospitalized because of that, results in the path analysis would have been different.

CHAPTER VI

CONCLUSION

A proposed research model for fall prevention, fall detection, and fall monitoring gerontechnologies among older adults based on the innovation-decision process (Rogers, 2003) was tested with 15 hypothesis organized in eight groups. Although some hypotheses were not supported, this proposed research model has numerous implications. Until now, there has been little research to investigate the diffusion of gerontechnology for aging-in-place among older adults, specifically the diffusion of fall prevention, fall detection, and fall monitoring gerontechnologies. The main path of the model (knowledge, persuasion, and decision stages) appeared to have the most significant relationships, while the variables that influence this main path would vary from type to type of fall-related gerontechnology. Among the variables around the main path, technology readiness and sources of information were significant at least in one stage of the model for each type of gerontechnology. These variables could be considered important factors in the decision-process for fall prevention, fall detection, and fall monitoring gerontechnologies.

In addition, this study emphasized the importance of aging-in-place for older adults, but it also showed that the desire for aging-in-place does not necessarily trigger the fall-related gerontechnology decision process. Older adults in Oklahoma are willing to make efforts towards aging-in-place, but it does not necessarily include the adoption of fall prevention, fall detection, or fall monitoring gerontechnologies.

Until now, there were minimal studies investigating the relationship of older adults' interior design perceptions and gerontechnology. This study showed that interior design perceptions could have a negative correlation with purchase intention of fall-related gerontechnology. The results of this study give insights for the implications that follow.

Implications

This study has theoretical and practical implications. The results of this study yielded some valuable information on the diffusion of gerontechnology for fall prevention, fall detection, and fall monitoring among older adults for aging-in-place. The implications of this study provide researchers, interior designers, product designers, marketers, and educators with information about the stages of diffusion of fall-related gerontechnology. Moreover, this study provided information on how is the perceived knowledge of older adults living in Oklahoma about fall prevention, fall detection, and fall monitoring gerontechnologies and what are the better communicators about new technologies to older adults. Furthermore, the results of this study offer insights for professionals working with and for older adults in the state of Oklahoma.

Theoretical implications

As the current study showed, the Diffusion of Innovations Theory, particularly the innovation-decision process model, is a comprehensive and valuable theoretical framework for understanding the fall prevention, fall detection, and fall monitoring gerontechnology decision process. By identifying the relationships between the first three stages of the process, this study provided evidence that once the older adults get enough knowledge about the gerontechnology, positive attitudes towards a gerontechnology will lead them to the decision to purchase the innovation. However, at the moment, perceived knowledge on fall prevention, fall detection, and fall monitoring was considered low among the participants.

In addition, by using Diffusion of Innovation theory to develop a model of fall-related gerontechnology decision process, the current study confirmed the hierarchical flow from knowledge to attitude to adoption. In addition, the results from this study suggest that most participants lack of knowledge about the types of gerontechnology present in this study. It is important to notice that this study was conducted in the state of Oklahoma, a state predominantly rural, and therefore it is expected that the participants in this study would be less familiar with high-technology. On the other hand, unlike most prior research, by sampling an Oklahoma cohort, this study enriches the literature by examining the diffusion of fall-related gerontechnology in a predominantly rural state.

Results from this study give opportunity for the development of education modules about technology for aging-in-place, technology readiness, and fall-related gerontechnology for older adults, caregivers, and health services. In addition, results suggested that older adults rely on family to learn about new technologies. Therefore, education modules about innovations on gerontechnology could be developed for family members, especially to adult children. The education modules would be of important value when launching new gerontechnology, especially in rural areas like Oklahoma.

Moreover, besides testing the direct effects of knowledge on persuasion, and persuasion on decision, the current study tested the indirect and total effects of knowledge on decision when mediated by persuasion. This information brings insights on the innovation-decision process of fall-related gerontechnology.

The results from this study were in accordance to previous literature about aging-in-place when it confirms that most older adults prefer to remain living in their current residence for as long as possible emphasizing the importance of studies that seek for aging-in-place solutions (Hwang et al., 2011; Mihailidis et al., 2008).

This study contributes to the literature on interior design by addressing the issue of falls in the home environment, emphasizing the strong desire to age-in-place, and by investigating the diffusion of gerontechnology that could help older adults to overcome fall concerns, attaining aging-in-place for longer. In this study, the original model of innovation-decision process was modified to be adaptable to older adults' characteristics and concerns. Therefore, this model could be replicated to assess diffusion of other types of gerontechnologies with a cohort of older adults willing to age-in-place. In addition, because this theoretical model is divided in three stages (knowledge, persuasion, and decision), scholars are able to tailor de model to their specific research needs, including necessary constructs for each stage of the innovation-decision process.

Practical implications

Study results on knowledge, persuasion, and decision on fall-related gerontechnology are particularly pertinent to interior designers and marketing strategists of such products. This study revealed that most older adults are unaware of the existence of gerontechnology that could help them to overcome fall issues and help them to age-in-place. Also, because they are unfamiliar with such technologies, they do not hold a strong opinion about them. Marketing strategists of gerontechnology need to better communicate with older adults and their adult children across the Unites States, in both urban and rural settings. Moreover, they need to emphasize the benefits such gerontechnology may bring for aging-in-place. Marketing strategists should make a conscious effort to target older adults, considering them as individuals with purchase power, as this potential consumer have been changing their consumer behavior in the past decades.

Interior designers have the knowledge and tools to design residences that respect older adults' desire for aging-in-place. Therefore, they should consider the inclusion of some devices when designing residences for older adults, or at least preparing the environment for its later installation and presenting the options to their clients.

Limitations

There were some limitations associated with this study that need to be addressed. First, it should be noted that the current study has a limited external validity due to the fact that it was applied only in the state of Oklahoma. While most participants lived in an urban area, it is hard to generalize that the results would be the same if conducted with a sample from a larger urban center, where new technology usually gets adopted first. Second, the current investigation was also limited by the use of paper survey. While paper survey has higher response rate, it has limitations related to geography, time, resources, and sample size. This also has an effects on external validity. Thirdly, the current study was also limited by a cross-sectional study design. With a one-shot survey it is hard to grasp reasons behind the answers and it limits causal mechanisms of the results. A longitudinal study could have helped in the case of this study to explore if the information sheets in the survey had some influence on participants' responses about perceived knowledge, attitudes towards, and purchase intention of fall prevention, fall detection, and fall monitoring gerontechnologies.

Finally, this study had limitations regarding its data analysis method. In this study, Path Analysis through Multiple Regression was used and it has some limitations when comparing to Structural Equation Modeling (SEM) (Hoyle, 1995). First, regression analysis allows for only one dependent variable, whereas SEM allows for multiple dependent variables. Second, SEM allows for variables to correlate, while regression adjusts for other variables in the model. Lastly and more importantly, regression assumes perfect measurement, but SEM accounts for measurement error. In SEM it is possible to specify relationships among constructs that are purged at measurement error, so the estimates of the effects between predictors and outcome are unbiased (Bowen & Guo, 2012). These factors make SEM a more powerful analysis when comparing to Multiple Regression.

Suggestions for Future Study

Based on the results and implications of this study, the following suggestions and recommendations are presented.

1. The research design was developed as a one-time data collection, with no pretest or posttest survey. In the current study it could have interesting outcomes due to the information sheets that gave a brief explanation on each type of fall-related gerontechnology. A suggestion for future studies would be to include a pre and a posttest to be able to measure the impact of the information sheets on participants learning through the process of answering the survey.
2. This study was applied in the state of Oklahoma, mostly Oklahoma City area. Although this has important implications, it limits the generalizations of the results. Future research should include people from other places, including larger urban centers where technology is usually adopted prior to small cities and rural areas.
3. A paper survey was employed to collect data in this study. This type of survey, while increasing response rate, it decreases the total number of participants and the geographical area of impact. The same model should be tested through an online survey that could impact a broader area, helping with generalization of results. In addition, an online survey would reach a sample that already have a relationship with computer and Internet, perhaps changing results on older adults' knowledge, persuasion and decision towards fall-related gerontechnology.

4. Although the research model was tested for fall prevention, fall detection, and fall monitoring gerontechnologies, other types of gerontechnologies for aging in place should be tested. An option would be to test the model with some of the assistive technologies available in the market that promise to aid with aging-in-place.
5. The results for knowledge about fall-related gerontechnology were mostly low. This may be for the fact that most devices presented in the survey were cutting edge technologies, most of them not yet in the market. However, this may also be for a lack of perceived needs by the participants, since most of them have not experienced a fall and have not been hospitalized due to a fall. Future research should deeper examine reasons for lower levels of knowledge about fall-related gerontechnology.
6. Marketing strategies should be examined in order to approach older consumers. Most of the emergency technology in the market have been used by older adults living in assisted living facilities but not by those older adults willing to age-in-place in the community. The reasons might be lack of knowledge of its existence, high prices, poor design or perceptions of difficulties to operate. Reasons should be examined.
7. In this study, interior design was measured through the aesthetic viewpoint. For future studies, it should be included psychological aspects like place attachment and its dimensions (place dependence, place identity, nature bonding, family bonding, and friend bonding) and physical aspects, like safety, accessibility, intuitive use, flexible use, and other universal design aspects. By doing this a better relationship between interior design and gerontechnology acceptance in the home environment could be drawn.
8. This study was a cross-sectional study. A longitudinal study including qualitative analysis may provide better understanding for participants' responses.
9. This study focused on the first three stages of innovation-decision process. A future study can be extended to include all the five stages of the original framework.

10. In this study a series of variables were modified from the original model and tested their relationships with the first three stages of the innovation-decision process (knowledge, persuasion, decision). A future study focusing in other variables around the model could be implemented and tested for a better understanding of the gerontechnology-decision process.
11. Results from this study showed that most participants have good or excellent health and very low fall concerns. This study could be replicated with older adults who have more experience with falls and have higher concerns for their health.

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APPENDICES

Oklahoma State University Institutional Review Board

Date:	Thursday, October 19, 2017
IRB Application No	HE1762
Proposal Title:	Gerontechnology for fall prevention, detection, and monitoring: Examining the diffusion of technology among older adults for aging-in-place
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved   Protocol Expires: 10/18/2020

Principal Investigator(s):

Gabriela Fonseca Pereira	Mihyun Kang
	442 HES
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

RESEARCH PARTICIPANT CONSENT FORM
OKLAHOMA STATE UNIVERSITY

Title: Gerontechnology for fall prevention, detection, and monitoring: Examining the diffusion of technology among older adults for aging-in-place

Investigators: Gabriela Fonseca Pereira | Ph.D. Candidate

Mihyun Kang, Ph.D | Faculty Advisor

Purpose: The purpose of this study is to examine the diffusion of technology related to fall prevention, detection, and monitoring among older adults for aging-in-place. You must be 55 years or older to participate.

What to expect: After the research study has been presented to the participants, paper survey will be distributed among all people willing to respond. Participants will participate in one self-administered questionnaire that will take approximately 30-60 minutes to complete. The questionnaire consists of three sections. First section will ask questions about home environment; second section will ask questions about technology; and last section will ask questions about the participants, including age, gender, socio-economic and attitudes towards aging questions.

Risks: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life.

Benefits: There are no direct benefits to you. However, you may gain an appreciation and understanding of how research is conducted.

Compensation: There will be no compensation given for participating in this questionnaire.

Your rights: Your participation is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time.

Confidentiality: The records of this study will be kept private. Any written results will not include information that will identify you. Research records will be stored in a password protected folder on a password protected computer in a locked office that only the researchers will have access to. This data will be used towards the writing of the researcher's Doctoral dissertation. The data will be kept for two years and then destroyed.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study:

> **Gabriela Fonseca Pereira** | Ph.D. candidate | Department of Design, Housing and Merchandising | 431 Human Sciences, Oklahoma State University, Stillwater, OK 74078 (405)714-3424, gabrifp@okstate.edu

> **Mihyun Kang**, Ph.D. | Faculty Advisor | Department of Design, Housing and Merchandising | 434C Human Sciences, Oklahoma State University, Stillwater, OK 74078 | (405)744-4299

If you have questions about your rights as a research volunteer, you may contact IRB Office at 223 Scott Hall, Stillwater, OK 74078 | (405)744-3377 or irb@okstate.edu

CONSENT DOCUMENTATION

I have been fully informed about the procedures listed here. I have been able to ask questions and have had them answered by the researcher. I am aware of what I will be asked to do and of the benefits of my participation.

I affirm that I am 55 years of age or older.

I have read and fully understand this consent form. I understand that a copy of this form will be given to me.

By turning in the survey with my answers, I hereby give permission for my participation in this study.

Diffusion of fall prevention, fall detection, and fall monitoring Survey.

Dear participant,

Hello! This is Gabriela Fonseca Pereira, a Ph.D. candidate in Design, Housing and Merchandising at Oklahoma State University. I am doing research about fall prevention, fall detection, and fall monitoring technology to assist people to stay in their homes as they get older.

In order to investigate the gap between technology and older adults, I am doing a paper survey. This survey is composed of questions related to yourself, your housing preferences, and your relationship with technology.

Thank you for being part of this study.

Kind regards,

Gabriela Fonseca Pereira
Ph.D. candidate
Department of Design, Housing and Merchandising
Oklahoma State University

Section 1 – Let's start talking about yourself

01. What is your age?
(__) a. 55 to 64 years
(__) b. 65 to 74 years
(__) c. 75 to 84 years
(__) d. 85 years or older

02. You are:
(__) a. male
(__) b. female

03. How many people in your household are age 55 years or older (including you)?
(__) a. One
(__) b. Two
(__) c. More than two

04. What is your marital status?
(__) a. Married
(__) b. Widowed
(__) c. Divorced
(__) d. Separated
(__) e. Never married

05. About aging attitudes, please circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	There are many pleasant things about growing older.	1	2	3	4	5
b.	Wisdom comes with age.	1	2	3	4	5
c.	I feel excluded from things because of my age.	1	2	3	4	5
d.	I am losing my physical independence as I get older.	1	2	3	4	5
e.	Old age is a depressing time of life .	1	2	3	4	5
f.	Old age is a time of loneliness.	1	2	3	4	5
g.	It is a privilege to grow old.	1	2	3	4	5
h.	I don't feel old.	1	2	3	4	5
i.	Growing older has been easier than I thought.	1	2	3	4	5
j.	My health is better that I expected for my age.	1	2	3	4	5
k.	Problems with my physical health do not hold me back from doing what I want to do.	1	2	3	4	5

06. What describes your overall health condition?

(__) a. Excellent
(__) b. Good
(__) c. Fair
(__) d. Poor

07. What conditions do you have that makes it difficult to get around your home (if any)? (Mark all that apply)

(__) a. None
(__) b. Arthritis
(__) c. Back problems
(__) d. Knee problems
(__) e. Stroke
(__) f. General lack of mobility
(__) g. Use a wheelchair
(__) h. Vision problems/blind
(__) i. Hearing problems/deaf
(__) j. Other. Please specify. ____

08. What is your current employment status?

(__) a. Unemployed
(__) b. Retired and not working
(__) c. Retired and employed (or self-employed) part-time
(__) d. Retired and employed (or self-employed) full-time
(__) e. Employed or self-employed part-time
(__) f. Employed or self-employed full-time

09. What is your current annual household income including all sources of income from contributing adults, such as social security, retirement, alimony, etc.?
(__) a. Less than $50,000
(__) b. $50,000 to less than $75,000
(__) c. $75,000 to less than $100,000
(__) d. $100,000 to less than $125,000
(__) e. $125,000 to less than $150,000
(__) f. $150,000 or above

10. What is the highest level of education you have completed?
(__) a. No schooling completed
(__) b. Nursery school to 8th grade
(__) c. Some high school, no diploma
(__) d. High school graduate, diploma or the equivalent (for example: GED)
(__) e. Some college credit, no degree
(__) f. Trade/technical/vocational training
(__) g. Associate degree
(__) h. Bachelor's degree
(__) i. Master's degree
(__) j. Professional degree
(__) k. Doctorate degree

Section 2 – Now, let's talk about your home

11. How would you describe where your home is located?
(__) a. Rural area
(__) b. Small town
(__) c. City suburb
(__) d. City

12. What best describes your home?
(__) a. A single family detached home
(__) b. A multi-unit building (e.g. apartment, either low-rise or high-rise)
(__) c. A mobile home
(__) d. A semi-detached home (e.g. townhouse, or duplex)
(__) e. Other. Please specify. ____________________

13. Do you own or rent your place of residence?
(__) a. Own
(__) b. Rent
(__) c. Other. Please specify. ____________________

14. How long have you lived in your current residence?
(__) a. Less than 5 years
(__) b. 6 to 10 years
(__) c. 11 to 20 years
(__) d. 21 to 30 years
(__) e. 31 to 40 years
(__) f. 41 to 50 years
(__) g. Over 50 years

15. When was your home built?
(__) a. Before 1950
(__) b. 1951 to 1960
(__) c. 1961 to 1970
(__) d. 1971 to 1980
(__) e. 1981 to 1990
(__) f. 1991 to 2000
(__) g. 2001 to 2010
(__) h. After 2010
(__) i. Don't know

16. Do you think you will continue to live in your current residence for more than 10 years?
(__) a. Yes
(__) b. No
(__) c. I don't know

17. Have you made any plans for where you will live 10 years from now?
(__) a. Yes, I (we) have fairly defined plans
(__) b. I (we) have explored options
(__) c. I (we) have begun to talk about it
(__) d. No, I (we) haven't really thought about it

18. For each of the following statements about your living preferences, circle the number that best represents you.

	Statement	Strongly Disagree				Strongly Agree
a.	I prefer to remain living in my current residence for as long as possible.	1	2	3	4	5
b.	I prefer to seek a higher level of care (different living situation) as my needs change.	1	2	3	4	5
c.	Others' perceptions of my loss of independence would prompt me to move to a residence that could provide me with more care as I need it.	1	2	3	4	5
d.	If I were to need more assistance with daily living activities, I would rely more on my family to assist me to age in place rather than community resources.	1	2	3	4	5
e.	If I were to need more assistance with daily living activities, I would rely more on my social network to assist me to age in place rather than community resources.	1	2	3	4	5

19. What is your opinion about the interior design of your current residence? Circle the number that best represents your opinion for each of the following attributes:

a.	**Unenjoyable**	**Somewhat unenjoyable**	**Neutral**	**Somewhat enjoyable**	**Enjoyable**
	1	2	3	4	5
b.	**Poor looking**	**Somewhat poor looking**	**Neutral**	**Somewhat nice looking**	**Nice looking**
	1	2	3	4	5
c.	**Displeasing**	**Somewhat displeasing**	**Neutral**	**Somewhat pleasing**	**Pleasing**
	1	2	3	4	5
d.	**Unattractive**	**Somewhat unattractive**	**Neutral**	**Somewhat attractive**	**Attractive**
	1	2	3	4	5
e.	**Bad appearance**	**Somewhat bad appearance**	**Neutral**	**Somewhat good appearance**	**Good appearance**
	1	2	3	4	5
f.	**Ugly**	**Somewhat ugly**	**Neutral**	**Somewhat beautiful**	**Beautiful**
	1	2	3	4	5

20. If you think you will continue to live in your current residence in the future but there are some constraints, how might you overcome this situation? (Please choose one).

(__) a. Make plans to move (includes moving to a facility such as assisted living where care is provided or home of a family member or friend)
(__) b. Consider repairs or renovations
(__) c. Continue to live without any changes
(__) d. Get help from family
(__) e. Get help from other personnel resources
(__) f. Other. Please specify. ________________________________
(__) g. Don't know.

21. What is the MAIN REASON your home might present problems if you continue to live in your current home in the future? (Please choose one).

(__) a. Hard to maintain current home
(__) b. Inconvenient because of the design (Ex: bedroom in the second floor, steep stairways, etc.)
(__) c. Too old to fix or remodel home
(__) d. Too small for me
(__) e. Too big for me
(__) f. The house is not a problem
(__) g. Other. Please specify. __________________

22. What OTHER PROBLEM might you face as you continue to live in your current home in the future? (Please choose one).
(__) a. Hard to get medical services
(__) b. Hard to get housekeeping related services
(__) c. Hard to get emergency services
(__) d. Safety
(__) e. Bad location
(__) f. The neighborhood and community are not a problem.
(__) g. Other. Please specify. ________________________

23. In the last 3 years, have you fallen at home?
(__) a. Yes
(__) b. No. SKIP to question **26**.

24. Have you been hospitalized because of any of these falls?
(__) a. No, I have never been hospitalized because of falls that took place my home.
(__) b. Yes, I have been hospitalized once or twice because of falls that took place my home.
(__) c. Yes, I have been hospitalized three or four times because of falls that took place my home.
(__) d. Yes, I have been hospitalized five thru eight times because of falls that took place my home.
(__) e. Yes, I have been hospitalized nine or more times because of falls that took place my home.

25. Where about in your home and how many times in each place, these falls happened? (Mark all that apply and put the number of times).

(__) a. Living room, ________ times.
(__) b. Dining room, ________ times.
(__) c. Bathroom, ________ times.
(__) d. Own bedroom, ________ times.
(__) e. Other's bedroom/Home office, ________ times.
(__) f. Kitchen, ________ times.
(__) g. Stairs, ________ times.
(__) h. Laundry, ________ times.
(__) i . Corridor, ________ times.
(__) j. Garage, ________ times.
(__) k. Other. Please specify. ____________________________________,________ times

26. Are you concerned about falling while performing the following activities? Please, circle the number that best represents you.

	Statement	**Not at all concerned**				**Very concerned**
a.	Cleaning the house (e.g. sweep, vacuum, dust)	1	2	3	4	5
b.	Getting dressed or undressed	1	2	3	4	5
c.	Preparing simple meals	1	2	3	4	5
d.	Taking a bath or shower	1	2	3	4	5
e.	Getting in or out of a chair	1	2	3	4	5
f.	Going up or down stairs	1	2	3	4	5
g.	Reaching for something above your head or on the ground	1	2	3	4	5

Home modifications that vary from small changes to major modifications make it easier for you to live in your home as you grow older. Some examples include adding grab bars, replacing round doorknobs with lever handle, adding rooms, or installing ramps (Ahn, 2004).

27. Have you considered home modifications within the last 5 years?

(__) a. Yes
(__) b. No

28. Have you already made home modifications within the last 5 years?

(__) a. Yes. If YES, please describe. ____
(__) b. No

29. If you have considered or made home modifications, what was the major reason? (Please choose one)

(__) a. None. I have not considered making any home modification.
(__) b. For safety
(__) c. For comfort and convenience
(__) d. To live independently
(__) e. Other. Please specify. _____________________

Section 3 – Finally, let's talk about technology

30. How do you most often learn about newly introduced technology products for your home? Circle the number that best represents your opinion about each statement:

	Statement	Strongly Disagree				Strongly Agree
a.	To me, TV news, advertising, and current affair programs have been a valuable source of information on new technology.	1	2	3	4	5
b.	To me, newspapers have been a valuable source of information on new technology.	1	2	3	4	5
c.	To me, the Internet has been a good source of information on new technology.	1	2	3	4	5
d.	To me, radio advertising has been a good source of information on new technology.	1	2	3	4	5
e.	To me, other people (friends, family, etc.) have been a good source of information on new technology.	1	2	3	4	5

31. For each product or service listed below, please check if you have or do not have them.

		I have one	I do NOT have one
a.	DVD Player		
b.	Computer		
c.	Smartphone (eg. Iphone)		
d.	Wi-Fi		
e.	Satellite or cable TV		
f.	Microwave oven		
g.	Electric tooth brush		
h.	Video-phone at entrance		
i.	Voice-recognition door opener		
j.	Burglar alarm		
k.	Gas leak detector alarm		
l.	Remote controls for temperature or humidity		
m.	Remote controls for turning on/off lighting and dimming lamps		
n.	Remote control for rising/lowering shutters		
o.	Remote control for home appliance (eg. Oven)		
p.	Home theater system		
q.	Personal health remote diagnostic product (eg. Diabetes check of urine by special toilet)		
r.	Wireless health monitoring product (eg. Necklace or watch that can monitor and send alert if unsafe heartbeats are detected)		
s.	Emergency alert product (eg. Pendant that can send a signal by pressing the button, in case of an emergency).		
t.	Video-cameras for activity monitoring		

32. Have you purchased a different technological product or service that is not listed above to aid you to age-in-place?

(__) a. No.

(__) b. Yes. Please specify all products and services. ____

____

____

____

33. About your opinion about technology, please circle the number that best represents you.

	Question	**Strongly Disagree**				**Strongly Agree**
a.	New technology contributes to a better quality of life.	1	2	3	4	5
b.	Technology gives people more control over their daily lives.	1	2	3	4	5
c.	In general, I am among the first in my circle of friends to acquire new technology when it appears.	1	2	3	4	5
d.	I can usually figure out new high-tech products and services without help from others.	1	2	3	4	5
e.	Sometimes, I think that technology systems are not designed for use by ordinary people.	1	2	3	4	5
f.	Too much technology distracts people to a point that is harmful.	1	2	3	4	5
g.	Technology lowers the quality of relationships by reducing personal interaction.	1	2	3	4	5

INFORMATION TO ANSWER QUESTIONS 34 - 37.

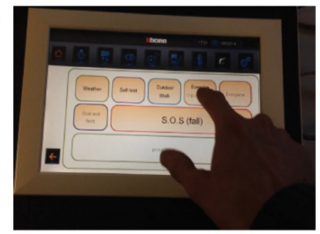
Fall prevention technologies *have been created to be pro-active in preventing falls, such as those which provide strength and balance training to older adults in the prevention of falls.*

Examples of fall prevention technologies and some of the characteristics:

1. Product: Motion Sensor Pager - TL-5102MP.
Developer: Smart Caregiver, USA.

- This system is installed next to a person's bed.
- This is an infrared sensor.
- It detects when a person is getting out of the bed.
- It automatically turns on the bedside lamp or other low intensity light, avoiding complete darkness when waking up in the middle of the night.
- The system can call the caregivers when a person gets out of bed.

2. Product: Smart home technology for fall prevention.
Developers: Norwegian University of Science and Technology, Norway; EPFL, Switzerland; SINTEF ICT, Norway; University of Bologna, Italy.



- This is a touch-screen system is installed in a preferred place at home.
- The system works for fall prevention and fall detection.
- Through the system, a person is encouraged to do muscle strength and balance exercises.
- Video clips appear on the screen, teaching the person how to perform exercises for muscle strength and balance.

Considering **<u>fall prevention technology</u>**, answer the following questions 34, 35, 36, and 37:

34. How much do you know about fall prevention technology? Please, circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	I know very much about fall prevention technology.	1	2	3	4	5
b.	I do not feel very knowledgeable about fall prevention technology.	1	2	3	4	5
c.	Among my circle of friends, I'm one of the "experts" on fall prevention technology.	1	2	3	4	5
d.	Compared to most other people, I know less about fall prevention technology.	1	2	3	4	5
e.	When it comes to fall prevention technology, I really don't know a lot.	1	2	3	4	5

35. How much do you believe that fall prevention technology can help you? Please, circle the number that best represents your opinion.

	Question	Strongly Disagree				Strongly Agree
a.	Fall prevention technology can help me to remain living at home.	1	2	3	4	5
b.	Fall prevention technology can keep me from falling.	1	2	3	4	5
c.	Fall prevention technology can keep me out of hospital	1	2	3	4	5

36. What is your overall opinion about fall prevention technology?

a.	What is your overall opinion of fall prevention technology?	**Very negative** 1	2	3	4	**Very Positive** 5
b.	How useful is fall prevention technology?	**Not at all useful** 1	2	3	4	**Very useful** 5
c.	How innovative is fall prevention technology?	**Minor variation of existing product** 1	2	3	4	**Completely new product** 5

37. What is your fall prevention technology purchase intention?

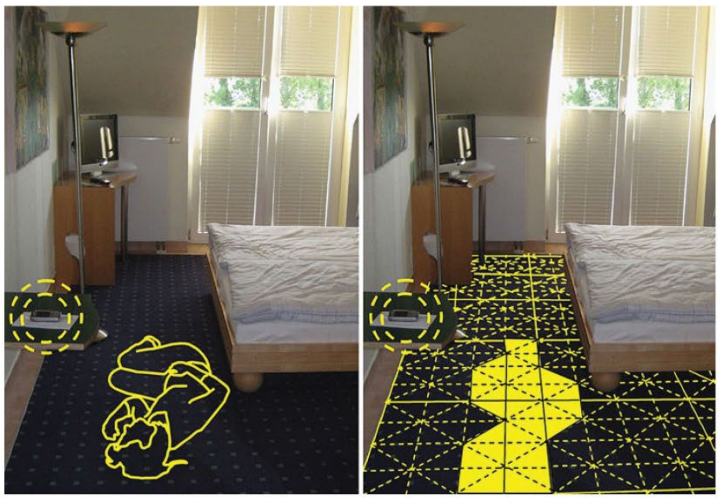
a.	How likely are you to purchase fall prevention technology?	**Very unlikely** 1	2	3	4	**Very likely** 5
b.	If purchased, how probable is it that you would use fall prevention technology?	**Very improbable** 1	2	3	4	**Very probable** 5

INFORMATION TO ANSWER QUESTIONS 38 - 41.

Fall detection technologies *have been created to be active in detecting falls, bringing help to older adults after the fall has occurred.*

Examples of fall detection technologies and some of the characteristics:

1. Product: SensFloor
Developer: Sesam, Germany



- This is a floor sensor and can be installed underneath your flooring.
- Because this is installed underneath your flooring, you can choose the flooring of your preference.
- The system identifies when a person falls because of the area occupied on the floor.
- The system calls for help immediately.

2. Product: Companion Robot
Developer: Oklahoma State University, USA

- This is a robot that stays with you in your house.
- You can talk to the robot and it can respond by voice.
- Among various activities, the robot can detect when a person falls.
- The robot identifies a fall even if it is not facing the person directly.
- The robot makes a video call to a family member to ask for help immediately after a fall has occurred.

Considering **<u>fall detection technology</u>**, answer the following questions 38, 39, 40, and 41:

38. How much do you know about fall detection technology? Please, circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	I know very much about fall detection technology.	1	2	3	4	5
b.	I do not feel very knowledgeable about fall detection technology.	1	2	3	4	5
c.	Among my circle of friends, I’m one of the “experts” on fall detection technology.	1	2	3	4	5
d.	Compared to most other people, I know less about fall detection technology.	1	2	3	4	5
e.	When it comes to fall detection technology, I really don’t know a lot.	1	2	3	4	5

39. How much do you believe that fall detection technology can help you remain living at home? Please, circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	Fall detection technology can help me to remain living at home.	1	2	3	4	5
b.	Fall detection technology is fast to call for help in case I fall.	1	2	3	4	5
c.	Fall detection technology can help to take me to the hospital after I fall.	1	2	3	4	5

40. What is your overall opinion about fall detection technology?

a.	What is your overall opinion of fall detection technology?	**Very negative** 1	2	3	4	**Very Positive** 5
b.	How useful is fall detection technology?	**Not at all useful** 1	2	3	4	**Very useful** 5
c.	How innovative is fall detection technology?	**Minor variation of existing product** 1	2	3	4	**Completely new product** 5

41. What is your fall detection technology purchase intention?

a.	How likely are you to purchase fall detection technology?	**Very unlikely** 1	2	3	4	**Very likely** 5
b.	If purchased, how probable is it that you would use fall detection technology?	**Very improbable** 1	2	3	4	**Very probable** 5

INFORMATION TO ANSWER QUESTIONS 42 - 45.

Fall monitoring technologies *have been created with real time monitoring of older adults activities and are connected to a response system in case of an emergency.*

Example of fall monitoring technology and some of the characteristics:

1. Product: Alarm.com - Wellness Elderly Monitoring
Developer: BeClose, USA

- This system is installed in all rooms of a person's house.
- The sensors are infrared.
- The base unit receives signals from discreetly placed sensors that are located around the house.
- Activities can be assessed by family members through the Internet
- It allows caregivers to remotely follow older adults' activities throughout the day, no matter how far away they are.

Considering **<u>fall monitoring technology</u>**, answer the following questions 42, 43, 44, and 45:

42. How much do you know about fall monitoring technology? Please, circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	I know very much about fall monitoring technology.	1	2	3	4	5
b.	I do not feel very knowledgeable about fall monitoring technology.	1	2	3	4	5
c.	Among my circle of friends, I'm one of the "experts" on fall monitoring technology.	1	2	3	4	5
d.	Compared to most other people, I know less about fall monitoring technology.	1	2	3	4	5
e.	When it comes to fall monitoring, I really don't know a lot.	1	2	3	4	5

43. How much do you believe that fall monitoring technology can help you remain living at home? Please, circle the number that best represents you.

	Question	Strongly Disagree				Strongly Agree
a.	Fall monitoring technology can help me to remain living at home.	1	2	3	4	5
b.	Fall monitoring technology can keep me from falling.	1	2	3	4	5
c.	Fall monitoring technology can keep me out of hospital	1	2	3	4	5

44. What is your overall opinion about fall monitoring technology?

a.	What is your overall opinion of fall monitoring technology?	**Very negative** 1	2	3	4	**Very Positive** 5
b.	How useful is fall monitoring technology?	**Not at all useful** 1	2	3	4	**Very useful** 5
c.	How innovative is fall monitoring technology?	**Minor variation of existing product** 1	2	3	4	**Completely new product** 5

45. What is your fall monitoring technology purchase intention?

a.	How likely are you to purchase fall monitoring technology?	**Very unlikely** 1	2	3	4	**Very likely** 5
b.	If purchased, how probable is it that you would use fall monitoring technology?	**Very improbable** 1	2	3	4	**Very probable** 5

VITA

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Doctor of Philosophy

Dissertation: GERONTECHNOLOGY FOR FALL PREVENTION, DETECTION, AND MONITORING: EXAMINING THE DIFFUSION OF TECHNOLOGY AMONG OLDER ADULTS FOR AGING-IN-PLACE

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