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Exploring predictors of technology adoption among older adults

Melinda Sue Heinz
Iowa State University

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Melinda Heinz

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Major: Human Development and Family Studies

Program of Study Committee:
Peter Martin, Major Professor
Christine Cook
Warren Franke
Jennifer Margrett
Johnny Wong

Iowa State University

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ABSTRACT

The purpose of this study was to investigate predictors of older adult technology adoption through a mixed methods perspective. One hundred and seventy-six older adults responded to a quantitative survey assessing their technology adoption. Four participants were selected for qualitative interviews. The mean age of participants was 74.71 years old that included an age range of 65-96 year old participants. The majority of older adults lived independently, and no participants lived in care facilities. In the quantitative phase, structural equation modeling in M*plus* was used to evaluate the fit of a technology adoption model using personality, self-efficacy, perceptions of technology, and attitudes of technology as predictors. Noteworthy findings indicated the model showed a good fit predicting technology adoption. Education, perceived usefulness, and attitudes toward using technology were positively associated with technology adoption. Participant age was negatively associated with technology adoption, indicating younger older adults were significantly more likely to adopt technology. Greater levels of agreeableness predicted greater levels of perceived usefulness and self-efficacy. Additionally, a significant indirect effect was obtained from perceived usefulness via attitudes toward using technology to technology adoption. This finding indicated that greater levels of perceived usefulness influenced more positive attitudes toward technology which in turn predicted greater levels of technology adoption. The qualitative phase indicated three themes specifically highlighting the importance of 1) earlier life experiences (e.g., workplace experiences), 2) personal preferences (e.g., choices regarding keeping up with technology), and 3) societal perspectives (e.g., concern for human interaction) on technology adoption. A revised theoretical model of technology adoption is suggested, tying together the quantitative and

qualitative findings of this research study. Lastly, future research should consider implementing lifelong learning opportunities teaching older adults the usefulness of technology and giving them a chance to interact with technology in a supportive environment.

CHAPTER 1. GENERAL INTRODUCTION

Technology has dramatically changed the world we live in by altering a number of environments and facilities including home, work, and healthcare facilities (Czaja & Lee, 2007). The invention of the computer and internet now allows possibilities that were once unimaginable (e.g., long-distance caregiving, remote tele-health care, and online social support). Such technological possibilities are related to the overall well-being of older adults, particularly regarding their health and independence (Mitzner et al., 2010).

Defining technology can be particularly challenging for researchers as technology can include an array of inventions ranging from vehicles to cell phones. For the purposes of this research study, the term gerontechnology will be used. In essence, gerontechnology includes linking technology to meet the needs of older adults to strive for increased quality of life (e.g., maintaining independence, increasing safety, and well-being) (Graafmans & Brouwers, 1989). Based on this definition, it is relevant to ask older adults about their computer use (e.g., e-mail, search engines, social media, shopping, banking, and chatting use). Asking older adults about which technologies they have adopted that are related to safety and maintain their independence and that are also relevant (cell phone, smart home use, and GPS navigation system use) to assess. Questions regarding technologies that promote independence (e.g., ATM use) and leisure time (e.g., DVD player and digital camera use) are related to quality of life as older adults may obtain enjoyment from using such technologies.

The technology acceptance model (Davis, 1989) is well known in the technology and aging literature for its theoretical explanation of factors that influence individual technology acceptance, although it has often been criticized for its lack of focus on the influence of individual characteristics on technology adoption (Arning & Ziefle, 2009). It instead focuses

on more societal factors such as attitudes toward technology and behavioral intention of use, which some researchers argue have greatly limited studying other factors associated with technology adoption (Bagozzi, 2007). More recently, cognitive and social factors have been considered, although the role of personality and self-efficacy in older adult technology adoption have not yet been researched. Therefore, a modified version of the technology acceptance model (Davis) will be proposed which will provide the framework to assess the influence of individual factors on technology adoption.

Older adults are indeed an important population to consider with regard to technology, as older adults make up the largest growing segment of the population (U.S. Census Bureau, 2011). As previously mentioned, there are long-range benefits to older adults adopting technology such as long-distance caregiving (Kinney, Kart, Murdoch, & Ziemba, 2003), access to tele-health care (Czaja & Lee, 2003), as well as overall well-being (Mitzner et al., 2010). Currently a digital divide exists between older and younger users of technology, as previous research has noted older adults are less likely to adopt and use technology (Olson, O'Brien, Rogers, & Charness, 2011). A digital divide is thought to occur when a gap in technology use exists between segments of the population (Brown, 2003).

In order to help narrow the digital divide among younger and older adults, it is important to consider individual characteristics and how such characteristics influence technology adoption. We often consider the digital divide and note there are differences between older and younger technology adoption rates, however researchers have not studied specific individual characteristics influencing technology adoption. Rogers (2003) indicated personality may play a role in technology adoption, but gold standard measures assessing individual characteristics are limited.

Technological development and the older adult population have both seen substantial increases in recent years, although the digital divide will only increase unless older adults continue to adopt technology. Recent research has linked technology adoption to well-being in older adulthood (Mitzner et al., 2010) although a digital divide still exists. Understanding the way in which individual factors influence and predict technology adoption can assist in narrowing the digital divide among younger and older adults.

The purpose of this study is to explore the influence of personality, perceived ease of use and usefulness of technology, attitudes toward technology, and self-efficacy on older adult technology adoption. Personality traits (e.g., extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination) may influence whether or not older adults adopt technology and which technologies are adopted (e.g., communication technologies, electronic technologies, etc.). Additionally, self-efficacy may also be related to whether or not technology is adopted at all. This research study will take a mixed-methods approach in understanding older adult technology adoption by collecting both quantitative and qualitative data. Mixed-methods research often allows for a richer, more complex understanding of the research study (Johnson, Onwuegbuzie, & Turner, 2007).

CHAPTER 2. REVIEW OF LITERATURE

This research discusses and explores older adult technology adoption. An overview of existing literature of older adult technology use will first be covered before moving into the theoretical applications and specific research questions. This study closely explored the role of older adult personality, perceived usefulness and ease of use of technology, self-efficacy, and attitude toward using technology on technology adoption. The Davis (1989) technology acceptance model served as a starting point for evaluating predictors of technology adoption rather than acceptance. The theory of diffusion of innovations (Rogers, 2003), provided one of the theoretical foundations for this study. Older adults will not be willing users of technology unless they see clear benefits in adopting technology. The way in which older adults perceive technology to be beneficial may depend on the cohort they grew up in. The life course theory takes this into account by acknowledging cohort and historical time period influences in older adult technology adoption (White & Klein, 2008).

Older Adult Technology Adoption

There is no strong consensus on whether or not older adults share similar opinions of technology, although more positive attitudes toward technology tend to outweigh negative viewpoints (Mitzner, 2010). Research has noted various findings, indicating that some older adults appear quite accepting and interested in adopting technology (Demiris et al., 2004; Heinz et al., 2013; McMellon & Schiffman, 2002). Yet other research has indicated resistance and apprehension related to technology adoption (Morrell, Mayhorn & Bennett, 2000). Although it is important to take into account older adults' attitudes and opinions regarding technology, more studies need to take into consideration why older adults hold

such attitudes and opinions of technology. In other words, assessing older adults' individual characteristics (e.g., personality and self-efficacy) may be predictive of technology adoption.

Widely accepted technology models such as the technology acceptance model (Davis, 1989) have been criticized for largely ignoring individual characteristics that may impact technology adoption and acceptance (Arning & Ziefle, 2009). Although there appear to be varying opinions of technology, personality facets and levels of self-efficacy may tell a great deal about why there is variability in older adult technology adoption and acceptance. Once we further understand the role of personality and self-efficacy in older adult technology adoption, we can attempt to decrease the digital divide between younger and older adult technology adopters.

Digital Divide

Although we may continue to see cohort differences in technology use and adoption rates, it is still important to educate older adults about the benefits of technology, particularly those older adults that did not grow up with such technological advancements as the computer. The digital divide may never be fully extinguished between younger and older adults, but we can work at narrowing the discrepancy. Some of the challenges associated with an aging population may be offset with technology adoption (e.g., tele-health can link rural older adults to accessible medical care; Czaja & Lee, 2003). Technology also increases the likelihood that social support among family members is maintained and the possibility that cargiving may be done from afar (Kinney et al., 2003). Long-distance caregiving is a reality in today's society, as family members are more likely to be spread out, living in different areas (Czaja & Lee). Particularly as families are more geographically dispersed in today's society, computer technology may assist with maintaining social support even into

very late adulthood. Likewise, online communities serve as a link for older adults to network and discuss issues they face; such forums are currently increasing in popularity (Nimrod, 2010).

Theoretical Application

Although there are many different ways in which to view the world and likewise frame this research, incorporating the diffusion of innovations and life course theories provide an organizational framework for understanding this study. If older adults perceive learning new pieces of technology to be highly useful and beneficial, their motivation and willingness to adopt such technologies into their lives is heightened. In the same regard, older adults who do not perceive technology to be useful are less likely to adopt such technology. However, the perception of usefulness may be unique depending on older adults' personality and level of self-efficacy. As Rogers (2003) described, diffusion is the process by which an innovation is communicated over time through members of a social system. The innovation aspect of the theory accounts for the relative advantages, compatibility, complexity, trialability, and observability regarding technology (Rogers). When linking the theory to older adults and technology use, relative advantages could be related to the benefits older adults perceive would result if they learned such technology. Compatibility may be how well learning new technology would fit in with the older adults' previous experiences with technology or expectations for learning such technology (e.g., how easy or difficult it is to learn a piece of technology in the past). Complexity would be related to how challenging older adults perceive the technology to be (e.g., how intuitive technology appears to be). Trialability could be connected to the trial period an older adult uses to adopt a new piece of technology in their lives (i.e., testing out how a Rumba vacuum works for a

few weeks). Observability may occur when older adults hear or see their friends using the internet and likewise decide to adopt the technology as they have "observed" their peers doing so.

Life course theory provides insight into older adult technology adoption and usage through a time and historical period framework by considering how previous historical aspects may influence later outcomes in individuals (White & Klein, 2008). Older adults did not grow up with the types of technology that youth of today are trained and skilled in. Older adults of today would likely have had to seek out opportunities to learn new types of technology as various forms of technology were not invented let alone taught through school or in the workplace (e.g., computer applications, cell phones, skyping). This factor likely plays a role in older adult levels of self-efficacy regarding their technology use. If older adults had relatively low levels of technology use and adoption in their lives, this may influence their level of self-efficacy in successfully adopting technology. Testing out a computer may seem intimidating and scary if older adults had never been exposed to computer applications in school or the workplace.

Personality may also influence technology use as well, based on Rogers' (2003) adopter category characteristics. Each of the adopter category characteristics Rogers discussed included aspects based on personality. For example, individuals that are the first to adopt technology are titled "innovators" (Rogers, p. 282). Innovators are typically more adventuresome and take more risks than other adopter categories. If older adults are open to trying new things, testing out technology, and potentially adopting it, technology adoption will likely be a smoother process than if older adults are reluctant to test out and experience

new products. Likewise, levels of extraversion and introversion may also influence what type of computer technology older adults adopt.

Conceptual Framework

As previously indicated, the technology acceptance model (Davis, 1989) provided a starting point for this study (see Figure 1). As the model indicates, technology use is predicted by unspecified external variables, perceived usefulness, perceived ease of use, attitudes toward using technology, and behavioral intent to use technology.

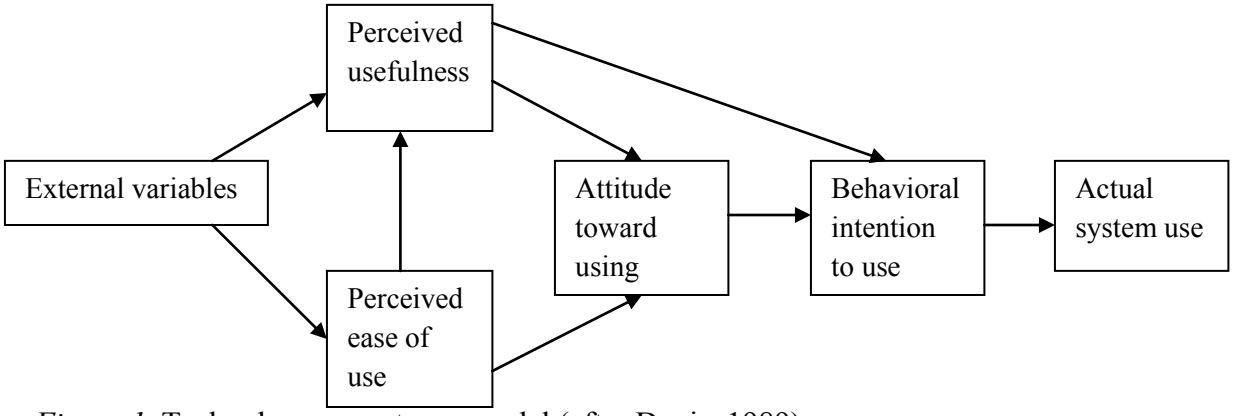

Figure 1. Technology acceptance model (after Davis, 1989)

A modified version of the technology acceptance model (i.e., technology adoption model) is proposed for the purposes of this study in order to more accurately predict technology adoption (Figure 2). In the proposed model, the external variables are more clearly defined than in the Davis model. Davis maintains that external variables such as individual differences likely influence behavior. The proposed model takes into account specific external variables such as individual characteristics (e.g., personality traits).

Perceived usefulness and ease of use were taken from the Davis (1989) model. However, self-efficacy was added to the model as it was not sufficiently addressed in the Davis model. Davis maintained that self-efficacy was captured in the "easiness of use" domain. However,

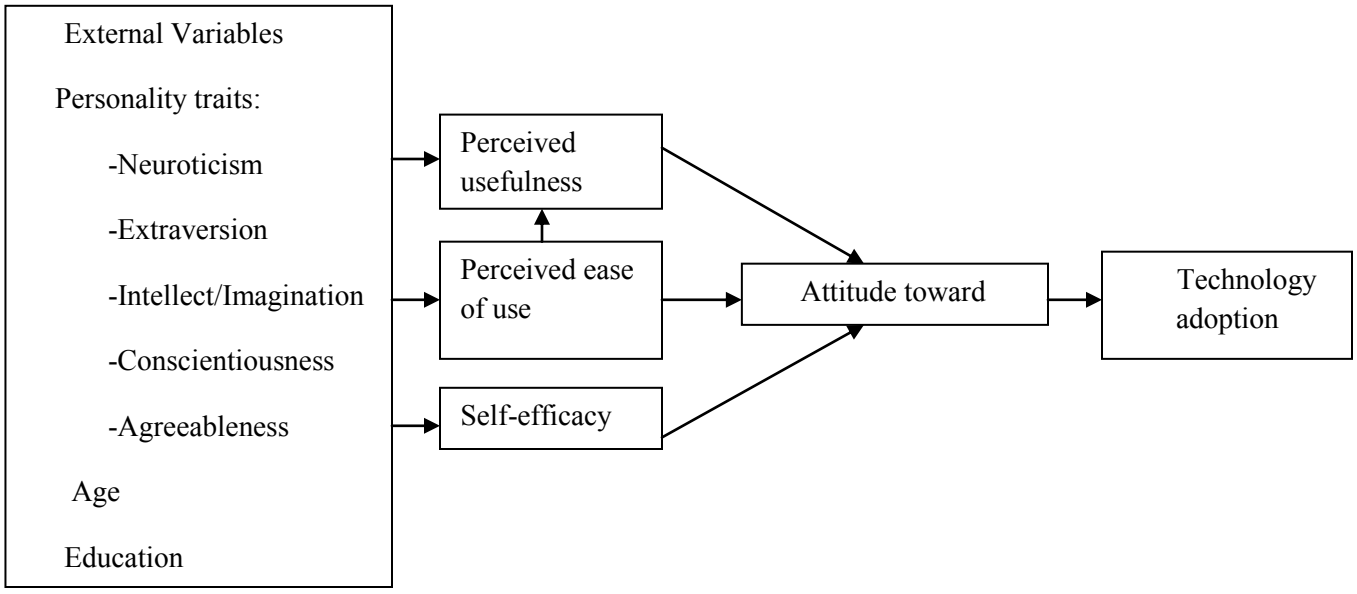

Figure 2. Proposed technology adoption model

there is reason to assume that self-efficacy and the ease of use of a particular product are quite different. For example, a technology product may be intuitive and designed quite well, but there may be potential barriers in its adoption simply due to the level of self-efficacy in an individual.

Attitude toward using technology is also included in the model as attitudes play a large role in motivations to use technology and ultimately adopting technology. Neither behavior intention nor actual intention to use technology are reflected in the proposed model. Instead, the outcome variable is simply overall technology adoption. Technology adoption reflects both behavioral intention and actual intention to use technology in a more simplified format.

Personality Traits

An important individual aspect that may influence technology adoption includes personality traits. Relatively little research has looked at the role of personality traits on

technology adoption and to the best of my knowledge, none has assessed the link between the Mini-IPIP (International Personality Item Pool; Donnellan, Oswald, Baird & Lucas, 2006) personality traits and older adult technology adoption. Rogers (2003) did discuss the fact that personality aspects may influence technology adoption, however using a standardized measure to study the influence of personality on older adult technology adoption has not been assessed.

Not surprisingly, the only studies assessing personality influence on technology use appear to be done with younger adults (Amichai-Hamburger & Vinitzky, 2010; Ehrenberg, Juckes, White, & Walsh, 2008). Previous research using the NEO-FFI assessing younger adult social communication technology use indicated that more neurotic individuals were more likely to use text messaging and instant messaging (Ehrenberg et al.). The authors speculate that such communication forums may give highly neurotic persons more time to read and respond to messages appropriately (Ehrenberg et al.), thus elevating their sense of control. This is interesting in that perhaps neurotic persons prefer less immediate technology as there is often less control associated with these forms of immediate technology (e.g., sending a text message may be more appealing for a highly neurotic person as a phone call may provide too much immediacy or unexpected spontaneity). However, such findings may not be directly transferable to older adults and should be researched to note similarities and differences between populations.

The role of personality has been previously mentioned in terms of technology adoption, when Rogers (2003) discussed personality characteristics associated with his five adopter categories such as "innovators, early adopters, early majority, later majority, and laggards" (Rogers, p. 280). Laggards make up approximately 16% of technology adopters

(Rogers). Although not directly tied to personality, the laggard category does include some personality components. In particular, laggards are typically conservative, less likely to change, and hold somewhat traditional values (Rogers). Even though such aspects do not necessarily fit neatly within the Mini-IPIP traits, it is important to note that personality aspects definitely do play a role in technology adoption. For instance, when looking at the first technology adopter category titled "innovators," such individuals are described as adventuresome, risk takers, and willing to accept setbacks (Rogers). Clearly, personality factors do have an influence on rates of technology adoption. The current research study is unique in that it will be using a standardized measure (i.e., the Mini-IPIP) to assess the role of personality on older adult technology use and adoption.

Age and Cohort Differences

Technology is developing rapidly and as a result common forms of technology will continually be replaced with more updated versions. Although some older adults may think of technologies such as televisions and cell phones to be relatively new, future cohorts will view those to be technologies of the past. In the same regard, future cohorts of older adults may have even greater acceptance rates of computers and other forms of existing technology (as they will have been around for quite some time) which may increase self-efficacy levels. Older adult acceptance of technology is also expected to increase as the boomer generation ages (Coughlin, 1999). In particular, boomers are predicated to have higher levels of education, better overall health, and more money at their disposal than older adults in today's society (Coughlin). Older adults of today did not grow up with computers as opposed to Boomers who have had encounters with computers at earlier time points in their lives (Hernandez- Encuentra, Pousada, & Gomez-Zuniga, 2009). Such differences between aging

Boomers and older cohorts of older adults alive today will likely change the way technology is viewed and perceived. Although acceptance and familiarity with certain technologies may increase over time, older adults are oftentimes concerned with maintaining their own independence and fear over-relying on technology will make them too dependent on it (Hernandez- Encuentra et al.).

Perceived Usefulness and Ease of Use

Research has noted that even though the transition to technology may be difficult for some, older adults anticipate needing technology in the future or that being adept at various technologies is necessary and will benefit them (Selwyn, 2004). Thus, it may be realistic for older adults to think futuristically about needs they anticipate encountering and how technology may assist them in meeting such needs.

However, as some older adults may be less inclined to think about the future, it is important for technology to appear useful and beneficial immediately in order to attract older adults. As Fisk, Rogers, Charness, Czaja, and Sharit (2009) indicated, in some instances the benefits of technology adoption may be unclear and, as a result, misconceptions may prevent older adults from adopting technology. Older adults may indeed want to adopt technology, but only if they perceive it to be beneficial and misconceptions do not stop them.

Perceived ease of use has been shown to be more critical for the oldest of older adults, whereas perceived ease of use was less critical for younger older adults considering adopting technology, specifically the internet (Pan & Jordan-Marsh, 2010). Such findings may point to the influence of cohort effects on perceptions of technology. Perceived ease of use of technology may be more important for the oldest of older adults simply because they may have had less experience during their lifetime with technology. Thus, technology that

appears to be easy to use on the onset may be highly valuable to older adults with less experience navigating various forms of technology.

Perceptions of technology usefulness may also be tied to perceived benefit. Previous research has noted that older adults' perceived benefits of technology were more predictive of technology acceptance than perceived technology expense (Mitzner et al., 2010). Such research indicates the strong role perceptions play in terms of accepting and ultimately adopting technology.

Self-Efficacy

Self perception evaluations of performance of specific tasks or goals has been described as self-efficacy (Bandura, 1977). It has been shown to be a strong predictor of individual abilities and accomplishments, as it has been known to influence what types of activities individuals engage in (Bandura & Cervone, 1983) and overall success (Paunonen & Hong, 2010). Self-efficacy in older adults has previously been assessed as it relates to older adult cognitive abilities. It has been shown to strongly predict cognitive performance ability (Seeman, McAvay, Merril, Albert, & Rodin, 1996). Therefore, such perceptions and evaluations could predict technology adoption rates.

Older adult self-efficacy levels may have dramatic influences on their abilities and ultimate adoption of technology. For example, lack of confidence can play a significant role in older adults' abilities to learn new information and successfully use communication technology (Marquie, Jourdan-Boddaert, & Huet, 2002). In fact, self-efficacy can be so influential that even when younger and older adults rate similarly on levels of memory recognition, older adults continue to rate themselves as significantly lower on computer-related knowledge than younger adults (Marquie et al.). Marquie et al. go on to point out

that contrary to popular belief older adult difficulty with mastering new technology may be more related to self-efficacy than any age related deficits (Marquie et al.). More simply put, older adults may have difficulty with technology because they hold low self-efficacy and feel they will not be successful users of technology. Researchers explain that self-efficacy is a powerful predictor of success as individuals with varying levels of self-efficacy likely engage in tasks differently and consequently perform quite differently regardless of initial ability level (Paunonen & Hong, 2010). Unfortunately, older adults seem to be buying into the idea that they cannot be successful users of technology.

When looking at differences between younger and older adult perceptions of self-efficacy (as related to cognitive tasks) older adults rate their self-efficacy as lower (Artistico, Cervone, & Pezzuti, 2003). Likewise, it would not be surprising if older adults rated their technology abilities lower than younger adults. The stereotype of older adults being more reluctant to agree to use technology innovations still exists today (Wagner & Wagner, 2003). Self-efficacy may be a barrier to computer use and adoption as previous research has noted older adults with greater computer fear had lower levels of computing self-efficacy, and in turn lower levels of computer knowledge (Karavidas, Lim, & Katsikas, 2005). Increasing older adult levels of self-efficacy and decreasing negative stereotypes regarding older adult technology abilities may allow older adults to reap the rewards of newer technology. However, if older adults are able to move beyond low-self efficacy concepts and adopt computer technology, Karavidas et al. noted that older adult computer confidence was related to increased levels of life satisfaction. The current research project will explore the influence of self-efficacy on technology adoption.

Attitudes Toward Technology

Older adult attitudes regarding technology have been investigated for quite some time with qualitative focus groups often used as the method of choice (Demiris et al., 2004; Heinz et al., 2013; Mitzner et al., 2010). Although Demiris et al., Heinz et al., and Mitzner et al. noted that participants appeared to have more positive than negative feelings regarding technology, older adults did appear to have some legitimate concerns regarding technology. For example, in some instances older adults reported concern over maintaining privacy and user-friendliness (Demiris et al.). Yet, other studies have found older adult concern over the lack of human connection some technologies offer (Heinz et al.) and inconveniences related to adopting technology such as the effort required to learn technology (Mitzner et al.).

Attitudes regarding technology may also have to do with more general aspects such as personal preference. Some older adults have adopted other more established forms of technology (e.g., a telephone), yet computer technology may not seem as critical to adopt as some older adults noted that they can accomplish similar tasks over the phone rather than with the computer (Selwyn, 2004). Older adults have also reported that they prefer to spend their time engaging in other hobbies that do not include using technology (Selwyn). Such attitudes regarding technology are likely very influential in final decisions regarding whether or not to adopt technology.

Research Hypotheses and Questions

The technology adoption model (Figure 2) indicates that external variables (e.g., personality, age, and education) directly influence perceived usefulness, perceived ease of use, and self-efficacy regarding technology. The model also specifies that perceived usefulness, perceived ease of use, and self-efficacy will directly influence attitudes toward

using technology. Finally, attitudes toward using technology will directly influence technology adoption.

The following research questions were based on the available literature regarding older adult technology adoption:

1. Do external variables (i.e., personality, age, education) predict perceived usefulness, perceived ease of use, and self-efficacy?
    a. I predicted that the older the individual, the lower the level of perceived usefulness, perceived ease of use, and self-efficacy.
    b. I predicted that the higher the education, the higher the perceived usefulness, perceived ease of use, and self-efficacy.
    c. I predicted that older adults with higher levels of conscientiousness, intellect/imagination, extraversion, and agreeableness would report higher levels of self-efficacy.
    d. I predicted that older adults with higher levels of neuroticism would report lower levels of self-efficacy.
2. Does perceived usefulness, perceived ease of use, and self-efficacy predict older adult attitudes toward technology?
    a. I predicted that older adults who perceived technology to be useful would have more positive attitudes toward technology.
    b. I predicted that older adults that perceived technology to be easier to use would have more positive attitudes toward technology.
    c. I predicted that older adults with higher levels of self-efficacy would have more positive attitudes towards technology.

3. Do older adults' attitudes toward using technology predict technology adoption?
    a. I predicted that older adults' attitudes toward using technology would predict older adult technology adoption. Older adults that rated greater levels of comfort would have greater rates of technology adoption. Older adults that rated themselves as being more controlled and more dehumanized by technology would report lower levels of technology adoption.
4. Do perceived usefulness, perceived ease of use, and self-efficacy mediate any relationships in the model?
    a. Specific mediators of technology adoption were also tested in the model (e.g., perceived usefulness, perceived ease of use, and self-efficacy). I predicted that perceived usefulness, perceived ease of use, and self-efficacy would mediate the relationship between personality and technology adoption.
5. Do age and self-efficacy moderate any relationships shown in the model?
    a. I anticipated that greater levels of self-efficacy would moderate the relationship between personality and attitudes toward technology.
    b. I also anticipated that age would moderate the relationship between personality and attitudes toward technology, with older adults indicating a stronger association between personality and attitudes toward technology.

CHAPTER 3. METHODS AND PROCEDURE

Demographic information about the participants, the measures used, and the methods of data analysis are presented and addressed in this section. IRB approval was obtained from the Iowa State Institutional Review Board in order to conduct this research study (Appendix L).

Participants

Older adults that resided independently either in the community, an independent living community, or an assisted living community were asked to participate in this study. Older adults residing in skilled nursing home facilities were excluded due to the anticipated differences in access to technology. For example, it is unlikely that individuals living in a skilled nursing home have access to and use the same types of technology (e.g., computer accessibility is likely different). A research participant database available at the University of Iowa titled "STAR" (Seniors Together in Aging Research) was used to recruit participants.

During early August 2012, 200 surveys were sent to STAR registry participants from the University of Iowa. Reminder postcards were sent to participants that did not complete the survey approximately three weeks later reminding them to complete the survey or contact the researcher for a replacement survey. Sending reminder postcards to survey participants is consistent with the Dillman method indicating the importance of multiple contacts with participants in order to increase response rates (Dillman, 2000).

A total of 176 participants mailed in surveys, an 88% response rate. One hundred and ten participants were female and 66 were male (Table 1). The majority of participants were White (97.7%). Most participants were highly educated as approximately 70% completed a college degree, and 32% of participants went on to finish graduate school. Participants also

Table 1

Demographic Characteristics

Variable	*Frequency*	*Percentage*
Gender		
1. Female	110	62.5%
2. Male	66	37.5%
Total	176	100.0%
Ethnicity		
1. White	171	97.7%
2. Asian Indian	2	1.1%
3. Other/Prefer Not to Answer	2	1.2%
Total	175	100.0%
Education		
1. High School	24	13.7%
2. Trade, Business, Technical School	28	16.0%
3. College	67	38.3%
4. Graduate School	56	32.0%
Total	175	100.0%
Living Status		
1. House or Apartment	165	94.3%
2. Independent Living of a Retirement Community	9	5.1%
3. With Adult Children	1	.6%
Total	175	100.0%
Health		
1. Excellent	50	28.6%
2. Good	110	62.9%
3. Fair	15	8.6%
Total	175	100.0%

(table continues)

Table 1 *(continued)*

Variable	*Frequency*	*Percentage*
Eyesight		
1. Excellent	58	33.0%
2. Good	106	60.2%
3. Fair	9	5.1%
4. Poor	3	1.7%
Total	176	100.0%
	Mean	*Range*
Age	74.71	65-96

Note. Percentages may not add up to 100 due to rounding.

predominately lived in their own houses or apartments (94.3%). The majority of participants were in excellent (28.6%) or good (62.9%) health and also rated their eyesight with glasses or contacts as excellent (33%) or good (60.2%) with glasses or contacts. The mean age of participants was 74.71 years old with a range of 65-96 years of age. It should also be noted that the majority of surveys received from participants contained complete data. Missing data ranged from 0-5% of the sample, depending on the question.

After the quantitative data were entered and analyzed, four in-depth interviews with participants were conducted. The interviewees were selected using combined qualitative sampling approaches (i.e., maximum variation; Merriam, 2009 and critical case sampling; Patton, 2001) for participant selection. Maximum variation selection is “purposefully seeking diversity in sample selection to allow for a greater range of application of the findings by consumers of research” (Merriam, 2009, p. 229). Critical case sampling is selecting participants that "yield the most information and have the greatest impact on the development of knowledge" (Patton, 2001, p. 236). Also, given the fact that age seemed to

play an important factor in technology use, that criterion was also used to select participants in conjunction with overall technology use scores.

Of the 176 participants that completed surveys, 117 participants indicated they would be willing to be contacted for a follow-up interview. Maximum variation sampling was done by selecting two participants with relatively high technology use and relatively young ages (e.g., technology scores between 13-15, and aged 65-75) and two participants with very low technology use and relatively older ages (e.g., technology scores between 0-2 and aged 85+). Participant age and technology adoption scores were used as primary indicators based on the structural equation model results indicating that age was a strong predictor of technology adoption. I wanted to see if what I noted in the structural equation model could be verified in the qualitative interviews (e.g., would perceived usefulness, self-efficacy, and attitudes toward technology be discussed in further detail?). I was also curious about what other aspects would older adults discuss related to technology adoption. Why might older adults choose not to adopt technology? Additionally, I was interested to see what other factors participants would say impacted their technology adoption. Finally, in order to narrow down interview candidates even further, the critical case sampling technique was employed by reading participant qualitative comments from the open-ended question in the survey to justify who may yield more information on their technology use. In the survey, participants had the opportunity to respond to a single item qualitative question that asked "what other comments would you like to add regarding your opinions of technology?" Figure 3 visually demonstrates the selection process. Three participants were in the older/low adopter category, those three participants also had written comments responding to the open-ended item in the survey. All participants were female; no men were in this group. Additionally,

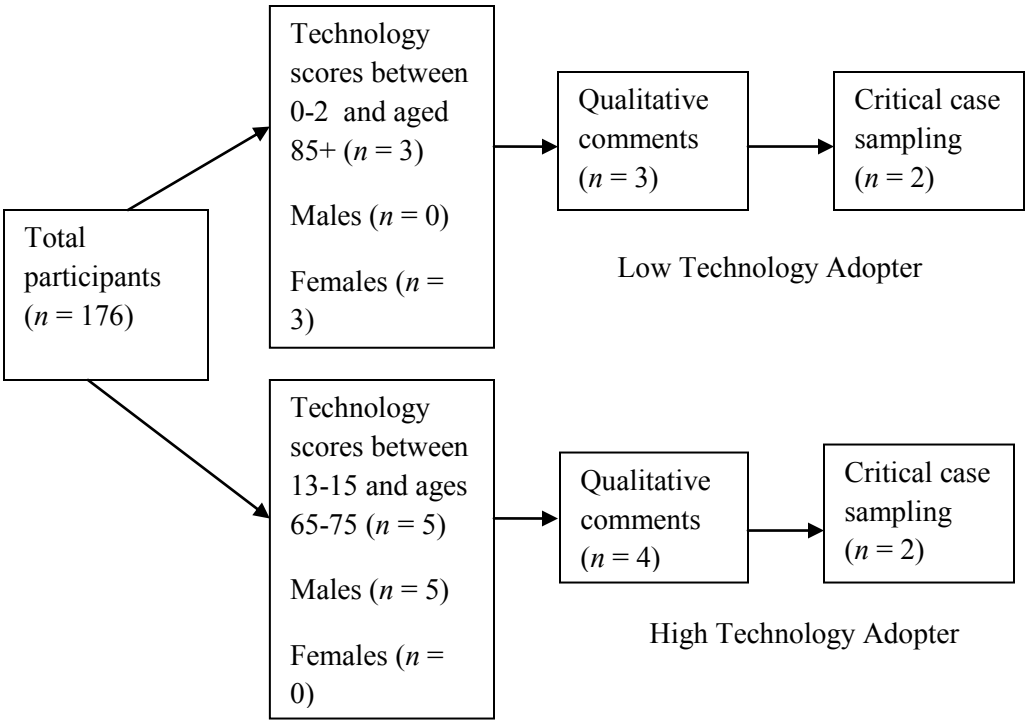

Figure 3. Qualitative interview selection process

participants were narrowed down based on the content in their open-ended response (i.e., I selected individuals who I thought would give me the most information surrounding preferences on technology adoption). Five participants were in the younger/high adopter category. All five participants were male and none were female. Four of the five participants responded to the open-ended question in the survey thus narrowing down candidates even further. Lastly, critical case sampling was again employed by reading answers to the open-ended question in order to determine who would provide the most information regarding their preferences on technology adoption. This rigorous, multi-step selection process illustrated the mixed methods nature of this study by incorporating both qualitative and quantitative criteria in selecting four participants for in-depth interviews. Specific information detailing why each older adult was chosen is described below.

"Harriet" was chosen for her low technology score (score of 0), age 85, and qualitative comments indicating that technology is stressful for her. Her discussion on stress may be related to attitudes toward technology that is shown in the model. During the interview, I hoped to find out more about what makes technology stressful.

"Barbara" was chosen for her low technology score (score of 2), age 86, and qualitative comments stating that technology is not needed in her life and she prefers to handle her business personally, without the use of technology for entertainment purposes. Her opinions may be related to perceived usefulness in the model as it appears she does not find technology to be particularly useful in her life. I hoped to find out more about why this is her preferred method.

"Don" was chosen for his relatively high technology score (score of 13), age 74, and qualitative comments reporting that he finds technology inspiring and refreshing, and useful for solving world problems. His relatively positive perceptions of technology seem to be related to attitudes toward technology in the model. I hoped to discover more about his perspective regarding positive uses of technology.

"Fred" was chosen for his very relatively high technology score (score of 15, also the highest reported score in the study), age 74, and qualitative comments indicating that he finds technology useful in terms of enhancing his daily life. "Fred's" comments seem to be similar to the perceived usefulness component in the model. I hoped to learn more about why he found technology useful and delve further into how he incorporated technology into his everyday life.

It should also be noted that although gender was not used as a selection criteria, there were no women in the relatively "high adopter" category (i.e., no women received scores

between 13-15 on the technology adoption measure) aged 85+ and no men in the relatively "low adopter" category aged 65-75. Therefore, any differences between relatively "high" and "low" users of technology may in part be attributed to gender. During the interviews, attitudes and self-efficacy influences on technology adoption were discussed in greater detail. To view the list of questions asked in each interview, please see Appendix J for an interview protocol sheet listing example questions and prompts.

Measures

Demographic variables. Gender, age, education, residential living status, previous occupation status, overall health, and visual impairment were collected from participants in order to assess their influence on other variables in the model (Appendix A). Participants were asked to provide their date of birth, and age was calculated. In addition, participants were asked to indicate their highest level of education received; response categories ranged from one year of grade school to obtaining a graduate or professional degree. Living status was assessed by asking residents whether or not they lived independently in the community or in an independent living or assisted living community. Self-rated health and visual impairment was also assessed in order to determine the extent to which health influenced technology adoption. Both the self-rated health and visual impairment questions were adapted from scales included in the Duke Older Americans Resources and Services Procedures (OARS; Fillenbaum, 1988).

Personality. The Mini-IPIP (International Personality Item Pool; Donnellan et al., 2006) was used to assess older adult personality (Appendix B). The 20-item measure had suitable reliability for all constructs (α = .65 to .83, Donnellan et al.). This study noted suitable

reliability for all constructs (e.g., extraversion α = .70, agreeableness α = . 77, conscientiousness α = .75, neuroticism α = .69, and intellect/imagination α = .73). Although the Mini-IPIP is a relatively new measure, it was seen as particularly advantageous to include as it is brief yet effective at ascertaining personality traits. Although the measure had not yet been validated with an older adult population, it was used for the purposes of this study as it was cost effective and relatively short. It should be noted that the Mini-IPIP has been validated with undergraduate students and showed acceptable convergent validity (ranging from .85 to .92 in one study; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004 and.83 to .94 in another, Donnellan et al.). The Mini-IPIP assessed multiple personality traits including: extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination. Example questions include "I seldom feel blue" from the extraversion dimension, "I sympathize with others' feelings" from the agreeableness dimension, "I get chores done right away" from the conscientious dimension, "I have frequent mood swings" from the neuroticism dimension, and "I have a vivid imagination" from the intellect/imagination dimension. Participants responded accordingly to each item indicating whether or not the item was "very accurate," "moderately accurate" "neither accurate nor inaccurate," "moderately accurate," "or "very inaccurate." The higher the score, the more accurately each dimension depicted the individual (e.g., the higher the score on neuroticism, the more highly neurotic an individual was).

Perceived usefulness. A modified version of the Davis (1989) scale of Perceived Usefulness was used to assess older adult perceptions of technology usefulness (Appendix C). The scale has previously been used with workers on the job to assess usefulness of electronic mail (Davis). In order to use the scale with an older adult population, the items

reflected general technology use (instead of targeting electronic mail) and were not directed at job performance. A total of ten items were included; four of the items were omitted as they were not pertinent to older adult perceived usefulness (e.g., "the electronic mail system addresses my job-related needs," "electronic mail supports critical aspects of my job," "using electronic mail improves the quality of work I do" and "using electronic mail makes it easier to do my job"). Examples of modified items include: "Using technology gives me greater control over my life," "using technology makes my life easier," and "overall I find using technology useful." For the original scales, previous research has noted high reliability (α = .97) and sufficient validity (Davis). This study also noted high reliability (α = .95) after the scale had been modified. Participants indicated whether they "strongly agree," "agree," are "neutral," "disagree," or "strongly disagree" with each item. The higher the score, the greater the perceived usefulness of technology. There were no subscales within the measure.

Perceived ease of use. A modified version of the Perceived Ease of Use scale (Davis, 1989) was used to assess older adult perceptions regarding the general ease of use of technology (Appendix D). This scale was previously used with working populations and had not been tested with an older adult population. The items in the measure were again modified to reflect technology in general (instead of focusing specifically on electronic mail). Examples of modified items include: "I often become confused when I use technology," "I find it cumbersome to use technology," and "I find it easy to recover from errors encountered when using technology." A total of twelve items were used to assess perceived ease of use. Two items were omitted from the scale as they focused too specifically on electronic mail and not general technology use (e.g., "the electronic mail system is rigid and inflexible to interact with" and "the electronic mail system provides helpful guidance in performing

tasks." Previous research has noted high reliability (α = .91) of the original scale and sufficient validity (Davis). This study also noted high reliability (α = .91) after the scale was modified. Participants indicated whether they "strongly agree," "agree," are "neutral," "disagree," or "strongly disagree" with each item. The higher the score, the higher the level of perceived ease of use of technology. There were no subscales within the measure.

Self-efficacy. Self-efficacy was assessed using a revised version of the general self-efficacy scale (Sherer et al., 1982). The revised version had been tested on older adult populations and sufficient reliability was noted (α = .73; Cooper, Huisman, Kuh, & Deeg, 2011). This study also found sufficient reliability (α = .82). Although sufficient construct validity was noted when the measure was correlated with other personality measures related to competency and self-esteem (Sherer et al.), specific information regarding the validity of the revised version has not been published. The revised measure included12 items, such as "I avoid trying to learn new things when they look too difficult," "When I make plans, I am certain I can make them work" and "When unexpected problems occur, I don't handle them very well" (Bosscher & Smit, 1997). Participants responded using a Likert scale ranging from strongly disagree to strongly agree. Items were summed together to create a total summary score of self-efficacy (Appendix E). In addition three subscales can be found in the measure (e.g., initiative, effort, and persistence). The higher the score, the higher the level of self-efficacy.

Attitudes toward using technology. A modified version of the Attitudes Toward Computers Questionnaire (Jay & Willis, 1992) was used to assess overall attitudes regarding technology (Appendix F). The scale was modified to reflect general technology use instead of specifically focusing on computer technology. There were a total of 35 items included in

the questionnaire. Seven specific dimensions were found in the questionnaire and have demonstrated sufficient reliability when tested with an older adult sample: comfort (α =.63), efficacy (α = .78), gender equality (α = .69), control (α = .54), dehumanization (α = .82), interest (α = .64), and utility (α = .67) (Jay & Willis). This study also noted sufficient reliability for all constructs (comfort α = .89, efficacy α = .88, gender equality α = .75, control α = .71, dehumanization α = .88, interest α = .79, and utility α = .76). Likert scale scoring was used to reflect participants' attitudes ranging from strongly agree to strongly disagree. Higher scores reflected stronger attitudes regarding technology for each subscale. No specific validity information was published in the original article (Jay & Willis).

Technology adoption. The level of technology use was assessed using a list of various technologies. A self-constructed measure was developed and included various technologies older adults may have been using (Appendix G). In addition, the measure was pilot tested (see Appendix H) with older adults to ensure appropriate items were included in the measure. Some of the items included in the measure have been adapted from the Everyday Technology Use Questionnaire (Rosenberg, Nygard, & Kottorp, 2009). However, only a subset of the measure has been published. Additional modifications or additions to the list were necessary in order to create a more accurate measure suitable for older adults. For example, the following items were excluded: using a pay phone, push button telephone, and radio (Rosenberg et al.) as such technologies have been around for quite some time and are outdated. Participants indicated "yes" or "no" to whether or not they used a specific technology. If the respondent answered "yes" they were prompted to move on to the following question that asks "approximately how often do you use this technology?" Respondents chose from the following response categories: "once a day," "once a week,"

"once a month," or "once every few months." The more items an older adult reported using, the greater the level of technology adoption. However, the measure also gave an indication of whether or not technologies were adopted minimally (e.g., only used every few months) or whether or not technologies were adopted regularly into an older adult's life (e.g., daily use).

Access to technology. Participants were asked whether or not they had access to technology where they were currently living by circling "yes" or "no" (see Appendix I) directly following the technology adoption measure. Determining whether or not participants had access to technology gave an indication of whether or not an older adult was likely to adopt technologies. For example, if an older adult did not have access to a computer, it was less likely he or she would adopt e-mail or Skype usage.

Mixed Methods

Both quantitative and qualitative methods of data collection were used in this study. The quantitative portion of the study was done first, followed with the qualitative portion. This separate phase method of data collection is known as a sequential explanatory approach (Creswell, 2008) in mixed methods research. The first step in this project was to pilot test the technology adoption measure with older adults (see Figure 4). After the technology adoption measure was created and pilot tested, quantitative methods were used to collect information regarding demographic information, personality, self-efficacy, perceived usefulness of technology, perceived ease of technology use, attitudes toward technology, and overall technology adoption.

Data Analysis

Pilot test. The data analysis plan began by pilot testing the technology adoption measure with older adults and obtaining their feedback regarding the measure. Such

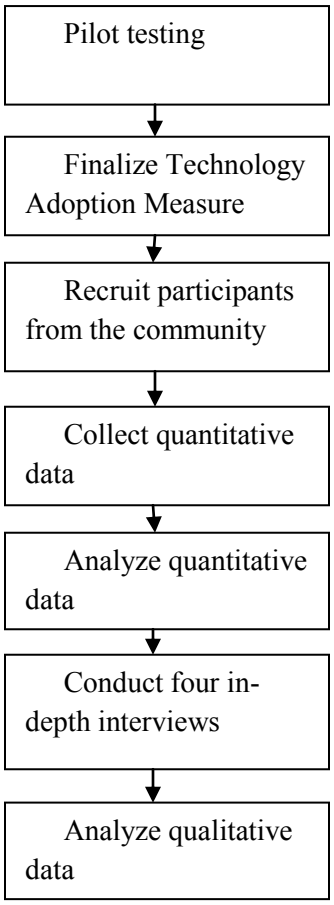

Figure 4. Data collection and analysis procedure

information was used to make changes to the technology adoption measure.

Descriptive statistics. After data were collected, descriptive statistics such as means, standard deviations, and frequencies were calculated using SPSS version 19. Cronbach's alpha was calculated in order to ensure reliability. Mean differences were analyzed among high and low levels of personality traits (e.g., extraversion and introversion) and the total level of technology adoption (e.g., summary score). For example, do individuals with relatively high levels of intellect/imagination adopt more technology than individuals with relatively high levels of neuroticism. Mean differences were also computed to assess

differences based on participant age (e.g., older versus younger) and education (e.g., high versus low levels).

Correlations. Bivariate correlations were computed to assess statistical associations among variables. Specifically, correlations assessed whether or not external variables were highly correlated with perceived usefulness, ease of use, and self-efficacy. Additionally, correlations assessed whether or not perceived usefulness, ease of use, and self-efficacy were highly correlated with attitudes toward using technology. Finally, the association between attitudes toward using technology and technology adoption was assessed.

Logistic regression. Logistic regression analyses were computed in order to determine whether or not external variables (e.g., personality) were more likely to influence specific technology use. For example, logistic regressions provided information on whether those ranking relatively high on extraversion were more likely to use cell phones than individuals with low levels of extraversion. This analysis was conducted for all technology adoption items and was exploratory in nature

Hypotheses testing. In order to test the hypotheses stated above, structural equation modeling was conducted using M*plus* (Muthén & Muthén, 2004). The model tested the direct relationship between external variables on perceived usefulness, ease of use, and self-efficacy, the direct relationship between perceived usefulness, ease of use, and self-efficacy on attitudes toward using technology. The direct relationship between attitude toward using technology and technology adoption was also conducted. The proposed model tested for indirect effects using the bootstrapping method. The first indirect effect tested was the influence of external variables (e.g., personality, age, education) on attitude toward using technology (through perceived usefulness, perceived ease of use, and self-efficacy). The

indirect effect of perceived usefulness, perceived ease of use, and self-efficacy as indirect predictors of technology adoption (through attitude toward using technology) was also assessed.

The results provided an indication of the goodness of fit of the model. Modified models were also taken into consideration when plausible paths were suggested to improve the fit of the model. Likewise, a parsimonious model was also considered if a simpler model was obtained while still maintaining a strong fit.

In order to assess the fit indices of the model, the χ^2 fit, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), standardized root mean square residual (SRMSR) and the Tucker and Lewis non-normed fit index (TLI) was used based on recommendations by Bentler and Bonett (1980), Bollen (1989), and Kline (2005). Modification indices offer suggestions for additional model specification that may result in a better fit. However, only theoretically based model changes should be undertaken.

Missing data. Because of the low number of missing data, no missing data imputation was conducted except for the analysis of structural equation modeling. M*plus* automatically calculates missing data by providing imputations using full information maximum likelihood (FIML) estimates.

In-depth interviews. In-depth qualitative interviews were conducted with participants after the analysis of the quantitative data was completed. An interview protocol was used in order to guide the interview process. Creswell (2008) recommended this method in order to structure the interview. Example questions and follow-up prompts can be found in Appendix J. The four in-depth interviews were recorded and later transcribed verbatim in order to be analyzed. Two trained students were paid to transcribe an interview, and I

transcribed two additional interviews. Both students had previous experience transcribing qualitative data and completed IRB training. An interview reflection sheet (Appendix K) was also completed following each interview in order to note general impressions of the interview, notes about what went well, what was difficult, etc.

The qualitative data were analyzed using the inductive data analysis procedure in which data are carefully broken down into smaller pieces until themes emerge from the data (Creswell, 2008). Codes were given to the data using track changes and highlighting in Microsoft Word. Next, categories were created based on the initial codes. Lastly, themes emerged from the data and will be reported in the results section. In addition, an interview reflection sheet was completed at the end of each qualitative interview (see Appendix K). As Creswell specified, this additional form of interpretation may be useful in understanding the data in a different way and may also inform future interviews with participants.

In order to ensure dependability, transferability, and confirmability, a member check was completed to make certain the data were accurately interpreted. A member check occurs when researchers take part of the refined data back to the participant in order to verify accuracy (Creswell). Using triangulation also adds validity to a study (Creswell) and is known as using multiple data sources in order to understand information. Due to the mixed-methods nature of this study, triangulation was sufficiently met. The qualitative data adds to the understanding of how external variables such as personality ultimately influence technology adoption. Likewise, a thorough exploration of attitudes was conducted to provide a more complete picture of how attitudes and perceptions ultimately influence technology adoption.

CHAPTER 4. RESULTS

Pilot Testing

Pilot testing was conducted with 17 older adults. Twelve participants from an older adult exercise group completed the survey and provided feedback. Two participants from an independent living retirement community completed the survey and offered no suggested changes. Additionally, three other participants reviewed the survey and had no suggested changes.

One participant from the exercise group proposed adding e-readers to the list of technologies. Participants also suggested minor formatting changes to make the survey more readable. A question on e-readers was added to the survey, and minor formatting changes were completed. After reviewing participant responses, it was apparent that some older adults were confused with the education question and marked answer choices under each category (e.g., they marked their highest education under high school, college, and graduate school instead of choosing just one category). Therefore, a question on total years of education was added where participants could write in their total years of education obtained. Some participants from the pilot testing reported confusion on which types of technologies the survey was specifically referring to. Consequently, an open-ended question was added at the end of the survey to allow for further explanation from participants.

Descriptive Information

Descriptive information is provided in Table 2. Overall, participants rated relatively highly on perceived usefulness and perceived ease of use. Participants also seemed to hold relatively high levels of interest in technology. In terms of personality, participants were

Table 2

Means and Standard Deviations

Variable	*Mean*	*Standard Deviation*
Education (scores range from 1-5)	3.89	1.01
Perceived usefulness (scores range from 10-50)	37.50	8.25
Perceived ease of use (scores range from 12-60)	36.17	8.09
Comfort (scores range from 5-25)	17.38	3.67
Interest (scores range from 5-25)	19.49	2.71
Utility (scores range from 5-30)	23.15	3.35
Self-efficacy (scores range from 12-60)	45.44	5.17
Extraversion (scores range from 4-20)	12.03	3.09
Agreeableness (scores range from 4-20)	16.35	2.59
Conscientiousness (scores range from 4-20)	16.41	2.44
Neuroticism (scores range from 4-20)	8.99	2.90
Intellect/Imagination (scores range from 4-20)	13.50	3.07
Technology Adoption (scores range from 0-16)	7.45	3.05

Note. Ranges reflect all possible scores, not the actual ranges of the sample.

relatively conscientious and agreeable. Likewise, they received relatively low scores on neuroticism. On average participants had adopted seven to eight technologies.

Correlations

Bivariate correlations were calculated for all variables (Table 3). In this section, I will highlight the specific variables correlated with technology adoption. Older adults that had higher levels of technology adoption were more likely to have higher levels of education $r(172) = .17$, $p < .05$ and were more likely to be younger $r(172) = -.38$, $p < .01$. Additionally, they were more likely to have higher levels of perceived usefulness $r(173) = .55$, $p < .01$ and higher levels of perceived ease of use $r(173) = .50$, $p < .01$. They had higher levels of self-efficacy, $r(171) = .17$, $p < .05$, including the self-efficacy subscale "initiative," $r(172) = .16$, $p < .05$. Regarding technology attitudes, those with higher levels of technology use had more positive attitudes toward the comfort of using technology, $r(166) = .45$, $p < .01$, gender equality $r(168) = .22$, $p < .01$, interest $r(173) = .43$, $p < .01$, and utility $r(173) = .37$, $p < .01$. They were also less likely to view technology as dehumanizing $r(170) = -.31$, $p < .01$.

Mean Differences

There were no significant differences in overall technology adoption between individuals with relatively high ($M = 7.92$, SD = 2.89) and low ($M = 7.07$, SD = 3.14) levels of extraversion $t(169) = -1.84$, $p = .07$, between individuals with relatively high ($M = 7.58$, SD = 3.07) and low levels ($M = 7.35$, SD = 3.03) of agreeableness $t(169) = -.49$, $p = .63$, or between individuals with relatively high ($M = 7.78$, SD = 3.36) and low levels ($M = 7.31$, SD = 2.84) of conscientiousness $t(168) = -.98$, $p = .33$. There were also no significant differences in overall technology adoption between individuals with relatively high ($M =$

Table 3

Correlations for Study Variables

Variables	1	2	3	4	5	6	7	8	9
1. Education	1								
2. Age	-.01	1							
3. Extraversion	.13	.08	1						
4. Agreeableness	.12	-.04	.35**	1					
5.Conscientiousness	-.07	.01	.17*	.24**	1				
6. Neuroticism	-.21**	-.03	-.18*	-.19*	-.14	1			
7. Intellect/Imagination	.14	-.09	.25**	.29**	.07	-.08	1		
8. Perceived Usefulness	.09	-.16*	.10	.17*	.08	-.02	.09	1	
9. Perceived Ease of Use	.15	-.21**	.03	.06	-.02	-.12	.17*	.50**	1

(table continues)

Table 3 *(continued)*

Variables	1	2	3	4	5	6	7	8	9
10. Self-efficacy	-.04	-.08	.27**	.25**	.38**	-.25**	.27**	.09	.28**
11. Initiative	.01	-.05	.19*	.15	.12	-.11	.21**	-.04	.32**
12. Effort	-.14	-.02	.14	.17*	.36**	-.07	.21**	.17*	.23**
13. Persistence	.06	-.10	.28**	.25**	.38**	-.41**	.21**	.02	.07
14. Comfort	.14	-.11	.09	-.04	-.00	-.12	.27**	.46**	.78**
15. Gender Equality	.18*	-.13	.09	.30**	.10	-.15	.11	.09	.14
16. Control	-.05	-.09	-.01	.13	.13	-.30**	.29**	-.01	.05
17. Dehumanization	-.16*	.09	-.10	-.13	.04	.08	-.26**	-.34**	-.40**
18. Interest	.04	-.10	.11	.16*	-.06	.04	.18*	.52**	.46**
19. Utility	.14	-.15*	.11	.24**	.03	-.06	.18*	.50**	.46**
20. Technology Adoption	.17*	-.38**	.15	.18	.06	-.02	.08	.55**	.50**

Note. *$p < .05$. **$p < .01$.

(table continues)

Table 3 *(continued)*

Variables	10	11	12	13	14	15	16	17	18	19	20
10. Self-efficacy	1										
11. Initiative	.76**	1									
12. Effort	.77**	.34**	1								
13. Persistence	.75**	.33**	.43**	1							
14. Comfort	.37**	.39**	.20**	.25**	1						
15. Gender Equality	.20**	.16*	.12	.21**	.23**	1					
16. Control	.25**	.12	.24	.24**	.09	.39**	1				
17. Dehumanization	-.23**	-.17*	-.10	-.24**	-.54**	-.38**	-.38**	1			
18. Interest	.33**	.29**	.28**	.17*	.51**	.33**	.13	-.55**	1		
19. Utility	.20**	.08	.18*	.20**	.48**	.37**	.34**	-.67**	.64**	1	
20. Technology Adoption	.17*	.16*	.06	.13	.45**	.22**	-.04	-.31**	.43**	.37**	1

Note. *$p < .05$. **$p < .01$.

7.69, SD = 3.25) and low levels (M = 7.29, SD = 2.93) of neuroticism $t(170)$= -.84, p = .40, or between individuals with relatively high (M = 7.69, SD = 3.35) and low levels (M = 7.34, SD = 2.64) of intellect and imagination $t(167)$= -.75, p= .45. There were no significant differences in overall technology adoption between individuals with relatively high (M = 7.75, SD = 2.80) and relatively low levels (M = 7.37, SD = 3.11) of education $t(170)$= .78, p = .44. However, there were significant differences between individuals that were older (M = 6.14, SD = 3.02) and younger (M = 8.53, SD = 2.62), $t(170)$= 5.55, $p < .001$. In other words, younger individuals were significantly more likely to use technology than older individuals.

Logistic Regressions

After completing logistic regressions, several personality traits were found to be predictive of specific technology adoption (Table 4). Older adults who were more agreeable were 22% more likely to use search engines than individuals with relatively lower levels of agreeableness, B = .20, $p < .05$. Older adults who were more agreeable were 52% more likely to use a cell phone than older adults with low levels of agreeableness, B = .42, $p < .001$. Older adults who were more agreeable were 17% more likely to use a digital camera than older adults with low levels of agreeableness, B = .15, $p < .05$. Older adults who were relatively high on intellect and imagination were 34% more likely to use Twitter than individuals with low levels of intellect and imagination B =.29, $p < .05$. Extraversion, neuroticism, and conscientiousness were not associated with technology adoption. It appears that agreeableness is the most important personality trait when assessing trait influences on technology adoption. However, it should be noted that some results found may have been due to a Type I error (i.e., incorrect rejection of a true null hypothesis), given that so many analyses were computed at one time.

Table 4

Personality Predictors of Technology Use

	Extraversion			Agreeableness			Conscientiousness		
Variables	*B*	*SE B*	*Exp(B)*	*B*	*SE B*	*Exp(B)*	*B*	*SE B*	*Exp(B)*
Email	.04	.08	1.04	.17	.10	1.18^{+}	.14	.11	.87
Search engines	-.02	.08	.98	.20	.09	1.22*	-.06	.10	.94
Instant messaging	-.02	.09	.99	.03	.11	1.03	.05	.11	1.05
Facebook	.03	.06	1.03	.11	.07	1.12	-.07	.08	.93
Twitter	.10	.14	1.11	-.18	.18	.84	-.17	.15	.85
Shopping websites	.06	.06	1.07	.12	.08	1.13	.06	.07	1.06
Online banking	.03	.06	1.03	.11	.07	1.11	.03	.07	1.03
Blog	-.89	.70	.41	.30	.47	1.35	-.54	.53	.58
Skype	.02	.07	1.02	-.05	.08	.95	.07	.08	1.08
GPS navigation	.06	.06	1.06	.02	.07	1.02	.11	.07	1.11
Cell phone	-.08	.10	.92	.42	.12	1.52***	-.08	.13	.93
Smart phone	-.00	.09	1.00	-.02	.11	.98	.06	.11	1.06
Money machine	.06	.06	1.06	-.02	.07	.98	.04	.07	1.04
Digital camera	.05	.06	1.05	.15	.08	1.17*	-.02	.08	.98
DVD player	.03	.08	1.03	.03	.09	1.03	-.10	.10	.91
eBook reader	.07	.07	1.07	.08	.09	1.08	.05	.09	1.05

(table continues)

Table 4 *(continued)*

	Neuroticism			Intellect/Imagination		
Variables	*B*	*SE B*	*Exp(B)*	*B*	*SE B*	*Exp(B)*
Email	-.04	.08	.96	-.10	.09	.91
Search engines	-.02	.08	.98	-.03	.08	.97
Instant messaging	.05	.09	1.05	.03	.09	1.03
Facebook	.03	.06	1.03	-.11	.06	.90^{+}
Twitter	-.11	.14	.89	.29	.15	1.34*
Shopping websites	-.00	.06	1.00	.04	.06	1.04
Online banking	.03	.06	1.03	.02	.06	1.02
Blog	-1.16	.79	.32	2.37	2.00	10.69
Skype	.01	.07	1.01	.05	.07	1.05
GPS navigation	.11	.06	1.12^{+}	.02	.06	1.02
Cell phone	.14	.11	1.15	-.00	.09	1.00
Smart phone	.05	.09	1.05	.05	.09	1.05
Money machine	.01	.06	1.01	.07	.06	1.08
Digital camera	.03	.07	1.03	.00	.06	1.00
DVD player	-.03	.08	1.09	.09	.07	1.09
eBook reader	.00	.07	1.00	-.11	.07	.90

Note. $N = 176$. *Exp(B)* = odds ratio. $^{+}p < 10$. $*p <= .05$. $***p < .001$.

Structural Equation Modeling

A series of six models (Table 5) were computed in M*plus* in order to test and modify the proposed model. The structural equation model was initially computed with all proposed variables (Model 1). The proposed model showed a relatively poor fit, χ^2 (df = 75) = 200.22, $p < .001$, CFI = 79; TLI = .68; RMSEA = .10; and SRMR = .07. Although the SRMR met the standard for an acceptable model, all other fit indices suggested that the model could be improved. Three personality variables were omitted (i.e., extraversion, intellect/imagination, and conscientiousness) resulting in Model 2 because they did not seem to predict any other variables in the model. This model indicated a better fit, χ^2 (df = 54) = 151.83, $p < .001$, CFI = .83; TLI = .73; RMSEA = .10; and SRMR = .07, although improvements were still necessary. To improve the model even further, several attitude indicators were omitted as they did not load highly on attitudes (e.g., gender equality and dehumanization). The model fit was χ^2 (df = 31) = 76.75, $p < .001$, CFI = .90; TLI = .81; RMSEA = .09; and SRMR = .05. Perceived ease of use was omitted from the model (Model 4) as it did not seem to directly or indirectly predict technology adoption. Modification indices indicated an acceptable fit of the model, χ^2 (df = 28) = 51.51, $p < .001$, CFI = .94; TLI = .90; RMSEA = .07; and SRMR = .05. Model 5 omitted neuroticism as it did not seem to indirectly predict technology adoption once perceived ease of use was removed. Modification indices indicated a good fit of the model, χ^2 (df = 23) = 37.97, $p = .03$, CFI = .96; TLI = .93; RMSEA = .06; and SRMR = .04. Lastly, in order to make the model more parsimonious, the attitude variable "control" was

Table 5

Fit Indices of the Technology Adoption Model

Models	χ^2	df	RMSEA	SRMR	CFI	TLI
Model 1 (proposed model)	200.22	75	.10	.07	.79	.68
Model 2 (modified personality)	151.83	54	.10	.07	.83	.73
Model 3 (modified attitudes)	76.75	31	.09	.05	.90	.81
Model 4 (ease of use omitted)	51.51	28	.07	.05	.94	.90
Model 5 (neuroticism omitted)	37.97	23	.06	.04	.96	.93
Model 6 ("control" attitude omitted)	29.15	15	.07	.04	.96	.92

also omitted as it did not load as highly on attitudes as the other remaining attitude variables. Model indices confirmed a good fit of the model χ^2 (df = 15) = 29.15, p = .02, CFI = .96; TLI = .92; RMSEA = .07; and SRMR = .04.

Direct effects. Significant direct effects were noted for perceived usefulness on attitudes toward technology (β = .48, p < .01) and self-efficacy on attitudes toward technology (β = .37, p < .001), indicating individuals with greater levels of perceived usefulness and self-efficacy were more likely to show positive attitudes toward technology (Figure 5). Attitudes of technology was also positively related to technology adoption (β = .30, p < .001), indicating that individuals with more positive attitudes toward technology were more likely to use more technology.

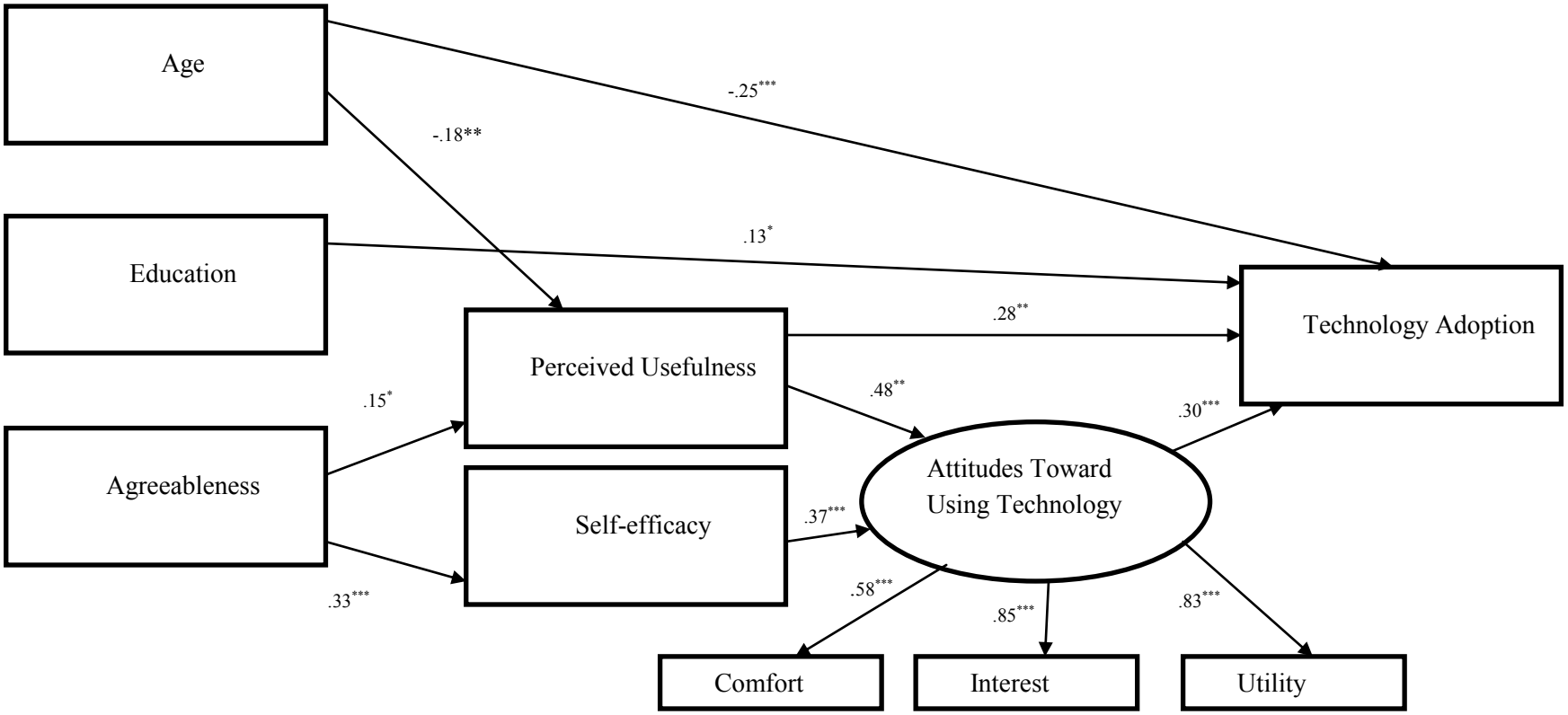

Figure 5. Structural equation technology adoption model

Significant direct effects were found between age on technology adoption (β = -.25, p < .001), education on technology adoption (β = .13, p < .05), and perceived usefulness on technology adoption (β = .28, p < .01), indicating that individuals that were younger, had relatively higher levels of education, and relatively higher levels of perceived usefulness of technology were more likely to adopt technology.

Significant direct effects were identified between agreeableness and perceived usefulness (β = .15, p < .05), indicating individuals with relatively higher levels of agreeableness were more likely to report greater levels of perceived usefulness of technology. Significant direct effects were noted between agreeableness and self-efficacy (β = .33, p < .001), indicating individuals with relatively higher levels of agreeableness were more likely to report relatively higher levels of self-efficacy. Significant direct effects were also identified between age and perceived usefulness of technology (β = -.18, p < .01), indicating younger individuals were more likely to report greater levels of perceived usefulness. The variables associated with technology adoption accounted for approximately 41% of the variance, and approximately 7% of the variance was explained for perceived usefulness. Approximately 13% of the variance was explained for self-efficacy, and approximately 46% of the variance was explained for attitudes toward technology.

Mediation. Perceived usefulness, self-efficacy, and attitudes toward technology were tested as mediators in the model using the bootstrapping method. The path from agreeableness to perceived usefulness to technology adoption was not significant. The path from self-efficacy to attitudes toward technology to technology adoption was not significant. The path from age to perceived usefulness to technology adoption was not significant. However, the path from perceived usefulness to attitudes toward technology to technology

adoption was significant, indicating relatively higher levels of perceived usefulness were associated with attitudes which in turn influenced technology adoption. The multiplied coefficient was .14, $p < .05$.

Moderation. Two moderators were tested in the model (e.g., self-efficacy and age). However, self-efficacy did not moderate the relationship between agreeableness and attitudes toward technology. Likewise, age did not moderate the relationship between agreeableness and attitudes toward technology.

Overall age, education, perceived usefulness, and attitudes toward technology predicted older adult technology adoption. Agreeableness had the strongest influence on perceived usefulness of technology and self-efficacy but was not related to technology adoption. Perceived usefulness of technology and self-efficacy significantly predicted attitudes toward technology which in turn significantly predicted older adult technology adoption.

The quantitative analysis did yield interesting information regarding predictors of technology adoption. In a next step, I evaluated qualitative findings to understand whether they would help further explain older adult technology adoption in similar or unique ways. Therefore, the next step in this mixed methods research design was to conduct the four qualitative interviews to explore technology adoption further through relatively high and low technology adopters. was valid. In this study, the first theme related to the impact of earlier life experiences on technology use.

Qualitative Analysis

Specific quantitative information for each interviewee is listed in Table 6 to help further understand predictors of technology adoption for each individual interviewed. The table

Table 6

Qualitative Interviewee Scores on Structural Equation Model Items

Variables	"Harriet"	"Barbara"	"Don"	"Fred"
Perceived Usefulness (scores range from 10-50).	24	12	50	41
Perceived Ease of Use (scores range from 12-60).	27	42	48	49
Comfort (scores range from 5-25).	15	20	22	24
Interest (scores range from 5-25).	13	18	25	24
Utility (scores range from 5-30).	22	21	30	27
Self-efficacy (scores range from 12-60).	46	44	54	48
Extraversion (scores range from 4-20).	15	8	12	11
Agreeableness (scores range from 4-20).	19	15	16	14
Conscientiousness (scores range from 4-20).	18	15	18	18
Neuroticism (scores range from 4-20).	6	5	8	7
Intellect/Imagination (scores range from 4-20).	15	18	20	14

Note. Ranges reflect all possible scores, not the actual ranges of the sample. Higher scores reflect greater endorsement of the variable. "Barbara's" scores on perceived ease of use and self-efficacy were calculated using the individual mean estimation procedure, given that she had missing data on some items.

indicates perceived usefulness, perceived ease of use, self-efficacy, attitude, and personality scores for each person. The relatively high adopters of technology selected for interviews had relatively higher scores on perceived usefulness, perceived ease of use, and slightly higher scores on attitudes and self-efficacy. Participants seemed to have varied personality traits with little to no differences between relatively high and low technology adopters.

Based on the qualitative interviews, three themes emerged: earlier life experiences, personal preferences, and societal perspectives. Specific categories under each theme are identified in Table 7. Some themes brought new perspectives to the conceptual model and enriched the understanding of model components. For example, discussion on stress related to using technology seemed to be related to attitudes toward technology. Likewise, comments about opportunities and human interaction seemed to be related to attitudes. Discussion on whether or not technology is necessary and useful or unnecessary seemed to be related to perceived usefulness. These qualitative findings offer additional suggestions for developing more refined models of technology adoption that incorporate findings from both the quantitative and qualitative portion of this study.

Additionally, "Don" and "Fred" were sent electronic copies of transcribed data via e-mail in order to fulfill member check requirements. "Don" gave no additional comments or suggestions, however "Fred" clarified and listed more technologies he was using. "Harriet" and "Barbara" were mailed pieces of transcribed data to check for interpretation accuracy. However, only "Harriet" responded indicating that she felt my interpretation of our interview

One of the criteria I used to select participants for qualitative interviews was their answers to the open-ended question, "what other comments would you like to add regarding

Table 7

Interview Themes and Categories

Earlier Life Experiences	Personal Preferences	Societal Perspectives
-Productivity in the workplace	-Independence	-Balance
-Exposure	-Convenience	-Future generations
-Seeking out opportunities	-Changes	-Opportunities
	-Motivation	-Changes
	-Accomplishing goals	-Human interaction
	-Stress	-Division
	-Unnecessary	-Productivity

your opinions of technology." Participant responses to the open ended question are shown in Table 8. Additionally, information regarding why participants were chosen and what I hoped to find out from the interviews is also shown in the table. Likewise, supplemental quotes from participants related to why they were chosen are illustrated in the table. For example, "Harriet" discussed her stress related to technology in more detail indicating a prior experience with technology and felt it raised her blood pressure. "Barbara" further explained why she preferred to handle her affairs personally rather than using technology. She also gave further insight into why she didn't feel she needed technology. "Don" went on to further discuss his positive attitudes toward technology and elaborated on his societal perspectives regarding technology. Finally, "Fred" also discussed ways in which he incorporated technology use in his everyday life. The next section will discuss each theme in more detail.

Table 8

Qualitative Participant Responses

Participant	*Responses to open-ended question*	*Why participants were chosen*	*Further elaboration from interviews*
"Harriet"	*"Technology makes life more stressful for me. I choose to do without it and enjoy a more relaxed approach to interacting with others. I enjoy written communication and use a phone extensively."*	- I hoped to find out more about what makes technology stressful.	*"If I can do it…add 2+2 = 4 without using the computer why would sit there and be frustrated waiting for the 4 to come up?"* *"But, it* [WebTV] *didn't work. I got so frustrated with it I just quit using it and when I left, I left it there. All it did was raise my blood pressure…"*
"Barbara"	*"I don't have a computer because I don't need one. Technology is very important. I was a pioneer in the use of computers and other technology in music education 25+ years ago. When I get so I can't get out and do all the things I'm doing, then I'll get a computer to have something to interact with. Until then, I'm going to handle my own business in a personal way. I have a cell phone for use in my car and don't even know its number because it's not for entertainment purposes but in case of car trouble on the road. I can discuss Twitter, Facebook, etc. with anyone, but it's not for me personally to use."*	-I hoped to find out more about why she prefers to handle her business personally without the use of technology	*"Well if I don't need it* [technology], *why have it?* *"I mean, let's use a bank statement and there's an error. If you happen to get somebody that's smart… 'oh yea I can go in and take care of that'…but half of the time you get people who can't use this* [points to head] *all they know is this* [computer], *and what comes up and if it's not right, they can't fix it."* *"I'm 86…and uh I've learned to do a lot of things that I need to do or want to do and I don't have to have a computer to do it."*

(table continues)

Table 8 *(continued)*

Participant	*Responses to open-ended question*	*Why participants were chosen*	*Further elaboration from interviews*
"Don"	*"I find technology exciting, refreshing, and inspiring. Most problems facing the world are solvable and technology is an instrument for greater effectiveness and efficiencies applied to these problems. Technology has proven to enlighten many throughout the world and increased communication beyond limits only imagined a few decades ago."*	-I hoped to find out more about why he found technology to be inspiring and refreshing. -I also hoped to find out more about his societal perspectives related to technology given that he felt world problems could be solved using technology.	*"It's exciting in the fact of coming from the innovation part of it is just 'what's around the corner?'"* *"Well I think that the internet has really opened that whole thing up that says…that gives you such a vast amount of information and to all people. "* *"There's ideas out there now that were never…well it would be like before the printing press. They may have been good ideas but they never got anywhere. And now it is just…it's the speed of light."*
"Fred"	*"I use technology to enhance my daily life and activities."*	- I hoped to learn more about why he found technology useful and delve further into how he incorporated technology into his everyday life.	*"We have adapted to the use of the iPads to facilitate the newspaper reading, getting news, communicating through e-mail, and in addition manage finances, pay bills, manage investments, and all of those every day kind of things."* *"What's very helpful is the ability to pick up the iPad and plan your route with the maps."*

Earlier life experiences. This theme included information on how earlier life experiences were influential on perceptions of technology and technology adoption. For example, early exposure (in work and home life), and situations in which the respondent described seeking out information about technology and its use were noted. Specifically, "Fred" spoke about the benefits of technology he had seen in the workplace. He stated,

> *I was an early adapter of PC and computers because I felt I could be more productive* [at work], *I could be more independent and I liked working with those kinds of things. So I was an early adapter, and consequently as technology evolved, I evolved with it. And that's where we arrived at today.*

Conversely, "Harriet" had a negative experience with technology when taking a keyboarding class in college that seemed to impact her decision to interact with a computer. She said, "*The only bad grade I ever got in my life was in typing…I don't know if that discouraged me or what. Throughout all of my professional life I was fortunate to have wonderful secretaries."* This comment seems to be related to her self-efficacy in that her low grade may have affected her confidence in successfully using technology. It is also possible that the difficulties "Harriet" encountered in her typing class may have lowered her perceptions about the perceived ease of use and perceived usefulness of technology. Consequently, it may have also influenced her attitudes toward technology.

"Barbara" seemed to use technology earlier in her life during her teaching career but deemed that she was at an age where technology was no longer needed. She stated, "*Because again if I were 50-55 I'd have it* [computer technology]. *But, I don't have to have the*

latest." She also went on to say *"But, if I were younger and I was in business especially, you better be darn sure I'd have one* [computer]*."*

"Don" stated,

> *It was when I first got introduced, well in fact I went all the way back to… I had a little bit of home experience with an old Commodore* [computer] *device and that was the introduction. And then I just evolved each time a new level* [of technology] *came up, I just kept moving into that*.

He also explained the importance of staying current with technology by upgrading with the latest devices when possible. He stated,

> *I took a course on computer trouble shooting and one of the things I got out of that was that you can upgrade so far but you need to be up with the latest technologies; just get the new device because the other stuff just doesn't . . . You end up like an old car.*

This theme also highlighted lifelong learning related to technology. Specifically, the relatively high adopters discussed how they evolved with technology as newer and more sophisticated products came out. Conversely, the low adopters were less likely to keep up with technology or learn about new advancements. This theme was not specifically included in the technology adoption model, but it is somewhat related to education (that was in the structural equation model) and workplace experience.

Personal preferences. This theme included both positive and negative aspects related to technology preferences. Positive aspects included information on how technology allows for greater independence, convenience, and the benefits of using technology to accomplish goals. Conversely, the negative aspects included discussion on how stressful technology can be to

use and how unnecessary technologies may be depending on individual preferences. This theme was not represented in the technology adoption model, but it does seem to be related to the "attitudes toward technology" component in the model. This theme emerged out of the discussion related to adapting to changing times. Some participants felt they should keep up with learning new technologies (i.e., lifelong learning) in order to stay current, whereas others were more content without doing so. Perhaps this finding can be related back to the model in that personality may impact perceived usefulness and self-efficacy. "Barbara," however, felt as though technology was not needed in her life currently. She stated, *"It's* [computer] *not a need."* Although she did report that if a time comes when she is more homebound she may consider using a computer to communicate with others by using Skype. Interestingly, this may be related to "Barbara's" perceived usefulness of technology (Skype in this case) not being particularly useful to her at this point in her life:

> "Barbara": *Except, which as I told you when I get to the point where I have nothing to do. If I just sit and watch TV all day…*
>
> Interviewer: *You might get a computer then?*
>
> "Barbara": *Yea, probably would. And if I get to feeling like, hey, I need to see the facial features, I'll get the computer and the Skype.*

"Don" also mentioned the importance of considering personal preferences before adopting technology as indicated in the discussion below:

> Interviewer: *So what would you tell someone that maybe struggles with technology? Would you recommend that maybe they seek out help from family and friends or go to a class or what would you think you would tell someone that really struggled with using technology?*

> "Don": *Well it depends on their inclinations. A lot of people that want to use, like, say for instance, a computer for limited number of things and they don't want to get involved in what it takes to determine what is wrong and go into problem-solving. I would suggest in that case if they got that propensity that what they do is find somebody that can do it for them because it's going to be frustrating for them. But then again if they have a real interest in the thing, I can give them a lot of hints and advice on where to go with that.*

These findings indicate that personal preferences are often as unique as the individual. Perhaps without at least some self-motivation to learn technology, teaching someone to use technology may be difficult. "Fred" may have summed it up best when he said, *"I guess what I would say, is that I haven't figured out how to get someone to adapt to technology that hasn't…is not self-motivated to do that."*

"Harriet" enjoyed life with minimal technology. She stated, *"I'm very peaceful without it. I do tons of reading. I write a lot."* She also went on to say that "*I understand a little bit about Twitter. Some of those kinds of things* [with social media]…*I don't make an attempt to really delve into it.*

"Don" seemed to enjoy using technology to keep busy. Don and his wife mentioned how useful online shopping was for them given their rural location. The affordability and convenience of online shopping was appealing to them.

Societal perspectives. The third theme was primarily concerned with broader perspectives and implications of technology relating to society as a whole. This theme also included positive and negative discussion surrounding technology. For example positive aspects included references to productivity and future opportunities due to technology

advancements. Conversely, negative discussion surrounded conversation on concern for technology use of future generations, lack of human interaction, and division between upper and lower classes. This theme was also a new area that was not included in the conceptual model of technology adoption. However, this theme does give a macro perspective on technology preferences and opinions from an older adult viewpoint and is somewhat related to the "attitudes toward technology" construct (e.g., some participants touched on how dehumanizing technology could be when they discussed how technology replaces some of the necessary human interaction). It should be noted that I asked participants directly about their broader opinions of technology including perspectives on technology in society. Both positive (e.g., new opportunities) and negative (e.g., overreliance on technology) perspectives were noted in this theme.

It was apparent that both "Harriet" and "Barbara" were very concerned about the negative impact technology has on society. "Harriet" often mentioned the "common good" indicating that technology may create a larger gap between the "haves" and "have nots." She stated, *"And with technology I think we're going to work ourselves into a situation where it's even more have and have not."* "Barbara" also noted that in some ways younger adults in society lack the forethought when posting inappropriate things on social media sites. She said, "*And you're hearing more and more about that because here are these kids that don't know any better…don't have any sense and they're putting stuff out on there and getting themselves in trouble."*

Much of what "Barbara" and "Harriet" said seemed to reiterate what many of the initial 176 participants voiced concerns over in the open-ended single item question on the survey (i.e., many participants discussed concerns for future generations regarding the use and

misuse of technology when responding to the single item open ended question). "Barbara" and "Harriet's" perspectives were able to give a deeper understanding to what the larger group was saying regarding concern for future generations.

Additionally, "Barbara" discussed aspects of employment that were related to "Harriet's" discussion on "haves" and "have nots" when she stated *"…that's one of the reasons why we have high unemployment because it's* [technology] *taking away jobs that are no longer there."* Interestingly, "Don" noted the exact opposite when he stated,

> *Well the one thing that always strikes me is the people that come up and say 'well, you know machines are everything. It's putting us out of a job.' I would say, 'who do you think is making the machines?' Those things have to be produced and made and that's…So yeah, I think that it* [technology] *is a win-win all the way around.*

"Fred" and "Don" seemed to discuss more positive societal perspectives (i.e., how technology can be used to make the world a better place or more advanced as a society). For instance, "Fred" stated "*Well, it's beneficial in that it allows the communications to take place. You know, whether it's friends or relatives or you can communicate with people all over the world."* "Don" also discussed productivity on a societal perspective when asked about his societal perceptions of technology. He stated "*Well it makes you more productive. It's exciting in the fact of coming from the innovation part of it is just 'what's around the corner?' It's kind of like walking down the river bank and seeing what's around the bend."*

Relying on technology too often was discussed more often by the low technology users. But, both "Fred" and "Don" did discuss how it can be detrimental. "Barbara" stated,

> *I'm afraid we don't have enough Bill Gates or* [Steve] *Jobs. These guys have the smarts to invent it, but we've got people using them* [computers] *who, if they did have*

their intelligence, they're not using their minds. They're letting the computer run the show.

Although "Fred" was an avid computer user, he also recognized that some people can rely too heavily on technology when he stated,

On the other hand, it can be detrimental, you can become a slave to that. With technology, the danger that you run is that your interaction with other people can become less and less important, interacting with a processor or computer.

Overall, participants seemed to hold varying views of technology (e.g., difference in perceptions related to the convenience, stress, and motivation to use technology, although commonalities were noted among all four participants and between the relatively high and low technology adopters. For example, all four participants seemed to explicitly touch on how their earlier life experiences (e.g., work or educational) impacted their attitudes toward technology and ultimately their technology adoption.

The older adults interviewed also seemed to mention that technology adoption is often related to personal preferences and that it may be difficult to encourage technology use if individuals are simply not interested in it. For example, the younger older adults/high adopters mentioned that they had to continually evolve in order to keep up with changing technology, whereas the older adults/low adopters did not deem it necessary to stay current with technology.

The low adopters of technology expressed concern about future generations use or misuse of technology, particularly related to social media. The low adopters also mentioned the growing separation between upper and lower classes due to recent technological advancements.

The societal perspectives theme added macro perspectives related to societal perspectives on technology. At times, the low and high technology users voiced opposite views of technology (e.g., job growth vs. job loss). However, there did seem to be agreement among interviewees when they discussed how technology can be detrimental when it takes the place of necessary human interactions and individuals become too dependent on technology.

Overall, these findings add to the understanding of older adult technology adoption above and beyond the quantitative model. Additionally, the interviews supplemented and further explained older adult perceptions and relationships with technology that would not have been possible with only a quantitative analysis.

CHAPTER 5. DISCUSSION

The purpose of this study was to explore the influence of personality, perceived ease of use and usefulness of technology, attitudes toward technology and self-efficacy on older adult technology adoption. The main finding of this research study showed the technology adoption model was successful in predicting older adult technology adoption. Additional findings from the qualitative interviews also yielded important information regarding older adult attitudes toward technology.

External Variables

Age, education, and personality consisted of the external variables in the model and will be discussed in the next section.

Age. I predicted that the older the participant, the relatively lower the level of perceived usefulness, perceived ease of use, and self-efficacy. Age did in fact predict perceived usefulness, in that younger older adults perceived technology as being more useful. Age was not predictive of perceived ease of use or self-efficacy.

Education. I hypothesized that higher levels of education would be linked to higher levels of perceived ease of use and usefulness. However, education was only directly linked to technology adoption in that more highly educated individuals were more likely to adopt more technology. Most participants were very highly educated, which may account for fewer direct effects. The link between education and technology adoption is not very surprising and is consistent with prior research. The Pew Internet and American Life Project (2004) noted individuals with less education were less likely to use computers and the Internet.

Personality. I predicted that older adults with higher levels of conscientiousness, intellect/imagination, extraversion, and agreeableness would all report higher levels of self-efficacy, and individuals with higher levels of neuroticism would report lower levels of self-efficacy. Agreeableness was the only trait that significantly predicted self-efficacy, indicating individuals with higher levels of agreeableness were more likely to have higher levels of self-efficacy.

Agreeableness also predicted perceived usefulness of technology but not perceived ease of use of technology. These findings indicate that individuals with higher levels of agreeableness were more likely to report that technology was useful to society and themselves. Previous research has also noted agreeableness as a significant predictor of perceived usefulness in a much younger sample of individuals in their 20s, 30s, and 40s (Devaraj, Easley, & Crant, 2008). This finding is particularly interesting given that different personality scales were used. Devaraj et al. used the NEO-FFI (Costa & McCrae, 1992), and this study used the Mini IPIP (Donnellan et al., 2006). Devaraj et al. maintained that personality does have a significant impact on technology acceptance. Although technology adoption was used in this model instead (i.e., not technology acceptance), findings from this study indicate that agreeableness was actually only predictive of perceived usefulness of technology and self-efficacy. Personality did not appear to have an impact on perceived ease of use and this path was thus eliminated from the structural equation model.

Logistic regressions indicated that individuals with certain personality traits were more likely to use specific technologies. For example, individuals with higher levels of agreeableness were more likely to use search engines than individuals who were more disagreeable. It is possible that more agreeable people are more willing to look up

information on their own to find answers. Individuals that had higher levels of agreeableness were also more likely to use a cell phone than their low-level counterparts. Other research conducted on personality traits and cell phone use noted similar findings on the agreeableness trait; Butt and Phillips (2008) found disagreeable individuals were less likely to be interested in incoming calls. Perhaps agreeable individuals are more likely to have and use a cell phone. It is possible that family members for some of the older individuals in this sample suggested that their loved ones buy a cell phone for emergency purposes. Perhaps these older adults were more likely to agree to suggestions given by their family members. Individuals with high levels of agreeableness were also significantly more likely to use a digital camera than individuals with relatively high levels of agreeableness. This finding may be due to more agreeable individuals accepting the responsibility of picture taking rather than asking someone else to be in charge of photographing instead. Also of interest were differences between those with high and lower levels of intellect/imagination and their Twitter use. Older adults that had relatively higher levels of intellect/imagination were more likely to use Twitter. This could in part be due to the fact that Twitter was one of the newest technologies included in the survey. Perhaps individuals that were had higher levels of intellect/imagination were more willing to try out the technology. This finding is similar to research by Correa, Willard-Hinsley, and Gil de Zúñiga (2010) that found individuals with greater openness were more likely to use social networking technology. This finding is particularly interesting given that the Correa et al. sample was younger and not made up of older adults. It is possible that differences in social networking preferences hold true throughout the lifespan. Agreeableness seems to be the most important personality trait because if individuals do not at least agree to learn about or use technology they are unlikely

to adopt it. There has to be at least some willingness to agree to accept it. As "Fred" mentioned during his interview, it may be quite difficult to encourage older adult technology use if older adults are not willing to at least agree to learn more about or experiment with technology. Previous research assessing younger adult technology use noted neurotic individuals were more likely to use instant messaging (Ehrenberg et al., 2008). However no significant association between neuroticism and technology adoption was found in this study. Perhaps this finding is true for younger adults but not older adults.

Perceived Usefulness, Perceived Ease of Use, and Self-Efficacy

I hypothesized that individuals who perceived technology to be more useful and easy to use would have more positive attitudes toward technology. However, only perceived usefulness significantly predicted attitudes toward using technology in that those with higher levels of perceived usefulness had more positive attitudes toward using technology. It is possible that since perceived usefulness and perceived ease of use were so highly correlated that they are virtually the same construct. Therefore, only perceived usefulness was identified in the structural equation model. These findings are not surprising given that our perceptions often influence our attitudes and a positive relationship was noted. I also predicted that individuals with higher levels of self-efficacy would have more positive attitudes toward technology. This hypothesis was also confirmed, as individuals with higher levels of self-efficacy had more positive attitudes toward technology. This finding is not surprising given that previous research has noted that relatively low self-efficacy may in part impact older adults experiencing greater difficulty with technology (Marquie et al. 2002).

Attitudes Predicting Technology Adoption

I predicted that older adult attitudes toward technology would significantly predict technology adoption. This hypothesis was confirmed as older adult attitudes toward technology did significantly predict technology adoption in the structural equation model. Individuals that had more positive attitudes regarding technology were more likely to adopt a greater number of technologies. This finding is not surprising given that previous research has established a link between attitudes toward technology and technology use (Czaja et al., 2006). Interestingly, previous research noted that greater levels of comfort and interest in computers led to greater computer use and computerized products/services (Umemuro, 2004). This study expanded those findings by assessing the impact of attitudes toward technology (including comfort and interest) on other types of technologies beyond just computers (e.g., cell phones, GPS navigation, Facebook, etc.). Findings from this study also indicated greater levels of comfort and interest were related to greater levels of technology adoption. Bivariate correlations indicated individuals that reported greater levels of comfort, gender equality, interest, and utility were more likely to adopt technologies listed in the survey. Individuals that reported greater levels of dehumanization and control were less likely to adopt the technologies listed in the survey.

Ease of use of technology was not predictive of technology adoption in the structural equation model, although perceived ease of use and technology adoption did have strong bivariate correlations with one another. Again, this is likely to have occurred due to the high correlation between perceived usefulness and perceived ease of use.

Mediation

I predicted that perceived usefulness, perceived ease of use, and self-efficacy would each serve as a mediator between personality and technology adoption. However, only attitudes toward technology proved to be a significant mediator between perceived usefulness and technology adoption. In other words perceived usefulness predicted attitudes toward technology which in turn predicted technology adoption. These findings seem to indicate that individuals who perceive technology to be more useful cause individuals to have more positive attitudes toward technology and ultimately impact greater technology adoption. If perceived usefulness did not cause such positive attitudes toward technology it is likely that rates of technology adoption would be reduced. It is possible that other mediators were not found given that the direct effects between variables were stronger than the mediating effects.

Moderation

I predicted that self-efficacy would moderate the relationship between personality and attitudes toward technology. I also predicted that age would moderate the relationship between personality and attitudes toward technology, although no significant moderation effects were obtained. It is possible that age and self-efficacy do moderate the relationships, but given the small sample size of this study, significant effects were perhaps not detected. It is also possible that neither age nor self-efficacy influence the relationship between personality and attitudes toward technology. Conversely, it is possible that other moderators may be more appropriate to test in future models (e.g., assessing social support as a moderator between attitudes toward technology and technology adoption) and could provide additional information regarding how useful social supporters are to older adult technology use and adoption.

Qualitative Interviews

The four qualitative interviews yielded additional findings not present in the quantitative analysis. For example, several commonalities were noted between the two relatively younger older adults/high technology users (e.g., both participants witnessed the efficiency and productivity of using technology in the workplace, both felt technology allowed for greater opportunities and efficiency, and both used technology to accomplish goals more effectively). Conversely, several commonalities were noted between the two relatively older/low technology users (e.g., both participants were relatively older in age and seemed to have significant in-person contact with friends or family members. It is possible that since both women were still relatively connected to their families and communities they did not view technology to be as useful to stay in touch. However, both women reported that if they were younger or still working they would likely be using more technology. It would be interesting to see what "Fred" and "Don's" answers would be when they reach their 80s. Perhaps "Fred" and "Don" would still be using relatively recent technology, or maybe like "Harriet" and "Barbara" they would feel such technologies would not be needed. The findings between the relatively high and low technology users seem to at least in part be attributed to cohort differences. "Fred" and "Don" were in their 70s, whereas "Harriet" and "Barbara" were in their 80s. Although gender was not initially of interest (e.g., gender was not a selection criterion for the qualitative interviews), it does appear some inadvertent gender differences were noted between the relatively high and low technology users in this study. At least in the two interviews conducted, men seemed to be using more technology than women and had more positive perceptions of technology due to workplace experiences. These differences may again be attributed to cohort differences in exposure to technology in

the workplace, as both men described seeing the benefits of technology in terms of productivity and efficiency. Additionally, both age and gender may be confounded. In other words, age alone, gender alone, or a combination of both may have influenced technology adoption. However, it is difficult to untangle age and gender as two older women were interviewed in the relatively "low technology use" group and two younger men were interviewed in the relatively "high technology use" group. Additional research should be conducted assessing the impact gender has on technology adoption, particularly prior exposure to technology in the workplace. It also appears that early life experiences (particularly work experiences as previously mentioned) influenced perceptions and use of technology. Both men appeared to have more positive views of technology as they had seen its benefit in the workplace. Both women on the other hand had slightly more negative views of technology. For example, "Barbara" mentioned that if she were younger she would be using it in teaching. "Harriet" also mentioned that she was able to rely on others to do her computer work when she was working. Oftentimes she reported she had *"good secretaries"* to do her typing. This would likely not be a feasible option today as computer skills are considered commonplace.

Further qualitative research should be conducted exploring older adult technology use. For instance, it is evident that earlier life experiences (e.g., workplace experiences and earlier exposure to technology) seem to be particularly influential on current technology use. A closer look at the influence of work experience on technology use should be conducted. Interviewing participants with a wide array of previous occupations and work experiences may be particularly useful. The mixed-methods findings of this research project also have implications for future theoretical models on older adult technology adoption.

Theoretical Model, Future Directions, and Application

After taking into consideration both the quantitative and qualitative findings of this study, a revised theoretical model on older adult technology adoption is proposed (Figure 6). Given that workplace experience seemed to impact technology attitudes and adoption, it was added to the model. Societal perspectives were also added to the attitudes toward technology variable cluster and encompassed both positive and negative sentiments from the qualitative interviews (e.g., concern for future generations of technology users, communication opportunities around the world, productivity, and the impact of technology on employment).

Personal preferences were also added to the model under attitudes toward technology. For example, an older adult may have used current technology when he/she was in the workforce, but now chooses not to keep up with certain forms of technology that are mainstream today thus influencing overall technology adoption. This example described "Barbara" in the qualitative portion of the study as she discussed being a pioneer of technology in music education, but now no longer stays up to date with technology due to her retirement. Lastly, lifelong learning opportunities were added to the model accounting for continued education opportunities as it was evident that the relatively high adopters of technology continued to learn about technology and embrace changes and advancements. These opportunities may expose older adults to various forms of technology as well as increase their technology self- efficacy by making them more comfortable with using such products. With continued exposure and education, technology self-efficacy and perceived usefulness may increase dramatically, ultimately creating more positive views of technology and greater technology adoption with various technological products. This model serves as a guide for future research in both quantitative and qualitative areas. Life span perspectives are also

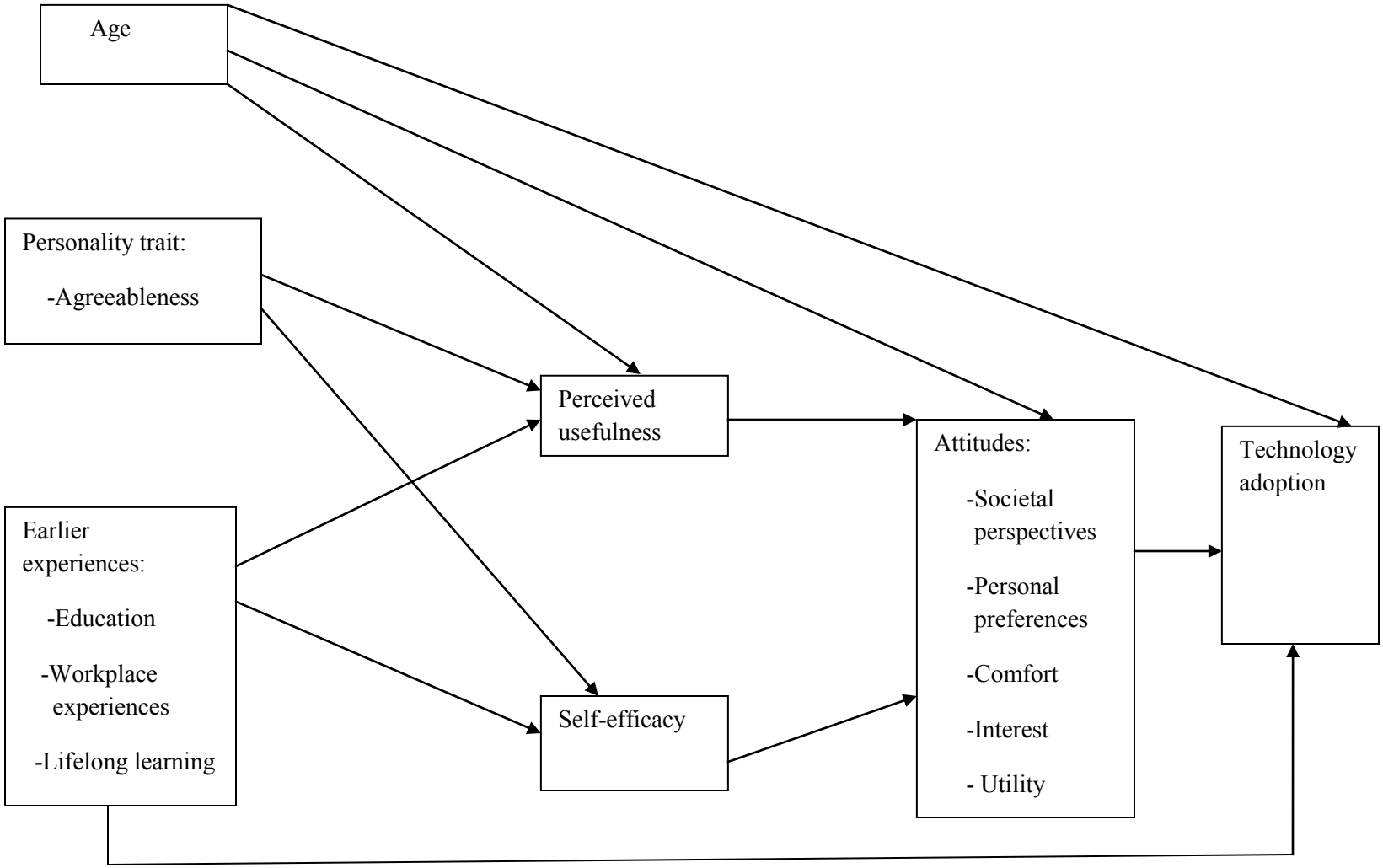

Figure 6. Theoretical model for future technology adoption research

incorporated into the model as a result of both earlier experiences and current attitudes impacting technology adoption.

Limitations

Several limitations are present in this study. For example, the majority of participants indicated their ethnicity was White (97.7%). It is possible that if participants with more diverse ethnicities had been included, technology adoption may have looked differently. Additionally, participants in this sample were very highly educated. Approximately 70% of the sample had completed college or graduate school. The high levels of education noted may have impacted perceptions of technology, attitudes of technology, and overall technology adoption.

All participants were recruited from a small geographic area in the Midwest. Due to the lack of geographic diversity, the findings of this study cannot be generalized outside of the Midwest. Additionally, the relatively small sample size of 176 participants is a limitation. Although four qualitative interviews were conducted and did contribute to further understanding older adult technology adoption, additional qualitative interviews are warranted. In particular, disentangling the effects of gender and age on technology adoption with greater numbers of older adults may be useful. Future research should be conducted with a larger number of participants to further validate results.

This study was cross-sectional in nature; therefore causality cannot be inferred. Finally, the measures used in the study may have impacted the results. For example, several measures were modified to reflect general technology use (e.g., perceived usefulness and perceived ease of use, and attitudes toward technology).

Additionally, some results may have occurred because of the many analyses that were computed in the logistic regression analyses. It is important to point out that these analyses were exploratory and a Type I error may have occurred (i.e., incorrect rejection of a true null hypothesis).

Future Research and Implications

This study has implications for researchers that would like to test programs in the field creating continued education opportunities for older adults to learn technology. It would be important to assess the effectiveness of continued education opportunities as well as how programs ultimately impact older adult technology self-efficacy and technology adoption. A pre- and posttest evaluating technology skills may be particularly useful to see how effective such programs are. The need for older adults to be aware of the usefulness of certain types of technologies is becoming more of an immediate need in today's society and in the future. Technology will soon become less of a choice and more of a necessity in order to stay current and meet one's own needs. We have seen this with "older" types of technologies that were once novel ideas that have now become commonplace in society ranging from the telegraph to more modern inventions such as the internet (Winston, 1998). If individuals do not adopt technology, they will likely be left behind because technology will be such a pervasive part of our lives. It is apparent that some older adults already recognize this as it was echoed in some of the qualitative interviews done in this study. Healthcare professionals are already investigating ways of offering telehealth communication using the Internet and/or video (Marziali, Dergal-Serafini, & McCleary, 2005). Technology is clearly where the future is headed and will not be slowing down any time soon.

However, it is apparent that some individuals will be more reticent to adopt technology than others, but time, energy, and resources should be spent assisting these individuals become more comfortable with technology so they are not left behind. Previous research has noted that technology allows older adults access to greater services that may increase their quality of life (Liu & Park, 2003). Given that many more services are now offered online, who will show older adults how to use technology in order to obtain such services? This obligation will likely fall on society as a whole to see to it that older adults are able to access services they need. But, encouraging older adults to think about how to incorporate and use technology in their lives now so that they will not be left behind is a much more pertinent and practical idea. Clearly, prior exposure (as evidenced in this study) seems to be beneficial to technology adoption. Therefore, introducing technology early may be best for older adults so that when they do need to access services by using technology they may be able to navigate our technological society with more ease. Based on this conclusion, lifelong learning will become more important in bridging that gap. There is an opportunity to create technology learning environments for older adults. Formal lifelong learning courses could be offered at universities related to learning technology where instructors teach courses on learning specific technologies. An innovative way could be to have courses led by students as a service learning component. This intergenerational component could be beneficial and offer learning opportunities to both parties. Students could meet throughout the semester and teach older adults about using specific technologies (e.g., e-mail, using search engines, blogging, etc.). Other learning opportunities could be developed in the community offering brief seminars at public libraries or community centers. Offering lifelong learning opportunities may also contribute to lowering the digital divide (Devins, Darlow, & Smith,

2002) between younger and older adults and provide for further understanding between generations.

Finally, we must not forget about the current cohort of older adults who could benefit from learning technology. Too often researchers focus on the future, but the time is now to teach older adults about the benefits of technology in their everyday lives. Developers of technology should also take into consideration older adult preferences and attitudes toward technology (Heinz et al., 2013). Older adults may have different perceptions about the perceived usefulness and attitudes of technology than younger adults. It is important to consider these differences and realize that different types of products may need to be developed for different people. Actively listening to what older adults want is paramount. Without doing so, technology developers may be more apt to create products that are not as useful for older adults.

From a life span perspective, older adults are never too old to learn something new. As Baltes (1987) indicated, there is still plasticity throughout the lifespan. In other words, the brain is still malleable and capable of learning new skills even very late in life. Development continues from birth to death allowing the possibility and opportunity for continued education and learning (Baltes, Staudinger, & Ulman, 1999). As a society, there are still many opportunities to involve older adults in lifelong learning whether it is learning new types of technologies or building other types of practical skills. Specifically, older adults may be able to gain social support online (Liu & Park, 1999). These online activities may be particularly beneficial for older adults that are less mobile and unable to leave their home frequently. Gains and losses are present throughout the lifespan (Baltes, 1997). Learning new skills and potentially receiving more support by using technology may be rewarding for

older adults. Likewise, using technology to compensate for age related declining abilities may also aid older adults in maintaining quality of life.

Thinking about technology adoption through a life span lens creates new ways to think about technology adoption. The ways in which we use technology may be very different throughout the life span. For example, in late adulthood, older adults may use technology to help offset losses often associated with aging (e.g., sensory impairment). Additionally, technology may be able to offset some of the challenges associated with aging such as impairments in activities of daily living (Liu & Park, 2003). Findings from this study note that perceptions of technology may also vary throughout the lifespan depending on prior exposure to technology and personal preferences. Although certain technologies may be developed with older adults in mind, developers must remember developmental differences present between younger and older adults. Such differences may impact older adult perceptions about how easy the technology is adopted and accepted (Liu & Park).

Future research should test the fit of the structural equation model with more diverse participants. It is evident that the variables included in the modified technology adoption model significantly predicted technology adoption in this sample. However, this should be tested in other areas outside of the Midwest. Testing the fit of the model with more diverse ethnicities and levels of education is also necessary.

Assessing the importance of financial resources and affordability of technology on older adult technology adoption should also be a consideration for future research. Perhaps older adults living on fixed incomes are unable to afford certain types of technologies (e.g., computers, eBook readers). Previous research has noted that for some older adults, cost was a factor impacting computer use (Morrell et al., 2000). This may in part influence lower

technology adoption. Consequently, it would be important to investigate how often older adults update the technologies they currently use and whether or not the affordability of technology is related to technology adoption.

Findings from this study elude to the fact that some older adults are willing users of technology and that certain characteristics point toward greater technology adoption (e.g., relatively higher levels of agreeableness, perceived usefulness, self-efficacy and more positive attitudes regarding technology).

Understanding older adult personalities may be a reference point in terms of how to begin encouraging technology use. Personality may impact the method of choice when encouraging and promoting technology use. In this study, agreeable individuals seemed to have greater levels of perceived usefulness and self-efficacy. Conversely, perhaps disagreeable people would need more time to experiment and interact with technology devices on their own. That may allow individuals time to draw their own conclusions about whether or not to adopt technology and may be a more successful approach for older adults than simply listening to someone (e.g., a family member) tell them why technology should be adopted. Although perceptions regarding perceived usefulness are highly personal and dependent on the individual, it is possible that individuals working with older adults (e.g., family members, long-term care staff) could "teach" about the usefulness of technology. For example, if an older adult does not find Skype to be useful, he/she could be taught about the usefulness of video chat in the long-term care or medical community when residents can relatively easily communicate with staff via a computer. Findings from Devaraj et al. (2008) suggested training about the usefulness of technology with a younger adult sample in the workforce. However, it is also possible that this could work outside of the workforce, for older adults no

longer working full-time. Incorporating the "one size fits all" approach with older adults and technology use assumes they all have the same personality traits and opinions. Therefore, when educating individuals about technology these differences can be accounted for and varying strategies and explanations can be used to educate and encourage technology use.

Findings from this study indicate that understanding technology adoption from a life span perspective may be more comprehensive. It appears that earlier life experience (e.g., education and work experiences) impact technology adoption. Likewise, it is also evident that agreeableness seems to be particularly influential on both perceived usefulness and self-efficacy and is the most influential personality trait in terms of understanding older adult technology adoption. Perceived usefulness and self-efficacy also influence more positive attitudes toward technology that in turn influences greater levels of technology adoption. Not surprisingly, both age and attitudes toward technology both influence technology adoption, with younger adults using greater technology. This study offers a unique contribution to technology and aging research and opens up a new area of uncharted territory that merits research in order to better understand technology adoption from a life span perspective.

APPENDIX A. DEMOGRAPHIC QUESTIONS

The set of questions include demographic questions about you. Please complete the questions below by circling or providing information for an answer.

1. What is your gender?
   a. Female
   b. Male
2. What is your date of birth?
   a. Birth month_____
   b. Birth date_____
   c. Birth year_____
3. What is the *highest* level of education you have completed?
   a. Grade school/High school: 1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th
   b. Trade, business, or technical school: 1yr 2yr 3yr 4yr 5 yr
   c. College: 1 yr 2 yr 3yr 4yr 5yr
   d. Graduate school: 1 yr 2yr 3yr 4yr 5yr 6yr
4. How many total years of education have you completed?
   _____
5. Where are you currently living?
   a. In my own home or apartment
   b. In an independent living portion of a retirement community
   c. In assisted living
6. What was your previous occupation?
   _____
7. How would you rate your overall health
   a. Excellent
   b. Good
   c. Fair
   d. Poor
8. Do you have any visual impairment
   a. Yes
   b. No
   If yes, please describe impairment_____
9. How is your eyesight (with glasses or contacts)?
   a. Excellent
   b. Good
   c. Fair
   d. Poor
   e. Totally blind

APPENDIX B: PERSONALITY

The next set of questions concerns your personality. Please indicate whether each statement very accurately, moderately accurately, neither inaccurately nor accurately, moderately inaccurately, or very inaccurately describes you.

	VERY ACCUR-ATE	MODERATELY ACCURATE	NEITHER ACCURATE NOR INACCURA-TE	MODEATELY INACCURATE	VERY INACCUA-TE
EXTRAVERSION					
1. I am the life of the party.	VA	MA	N	MI	VI
2. I don't talk a lot.	VA	MA	N	MI	VI
3. I talk to a lot of different people at parties.	VA	MA	N	MI	VI
4. I keep in the background.	VA	MA	N	MI	VI
AGREEABLENESS					
5. I sympathize with others' feelings.	VA	MA	N	MI	VI
6. I am not interested in other people's problems.	VA	MA	N	MI	VI
7. I feel others' emotions.	VA	MA	N	MI	VI
8. I am not really interested in others.	VA	MA	N	MI	VI
CONSCIENTIOUS-NESS					
9. I get chores done right away.	VA	MA	N	MI	VI
10. I often forget to put things back in their proper place.	VA	MA	N	MI	VI
11. I like order.	VA	MA	N	MI	VI
12. I make a mess of things.	VA	MA	N	MI	VI
NEUROTICISM					
13. I have frequent mood swings.	VA	MA	N	MI	VI

14. I am relaxed most of the time.	VA	MA	N	MI	VI
15. I get upset easily.	VA	MA	N	MI	VI
16. I seldom feel blue.	VA	MA	N	MI	VI
INTELLECT/IMAG-INATION					
17. I have a vivid imagination.	VA	MA	N	MI	VI
18. I am not interested in abstract ideas.	VA	MA	N	MI	VI
19. I have difficulty understanding abstract ideas.	VA	MA	N	MI	VI
20. I do not have a good imagination.	VA	MA	N	MI	VI

APPENDIX C: PERCEIVED USEFULNESS

The next set of questions concerns your perceived usefulness of technology in general. Please indicate whether you strongly agree, agree, are neutral, disagree, or strongly disagree with each statement.

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1. Life would be difficult without technology.	SA	A	N	D	SD
2. Using technology gives me greater control over my life.	SA	A	N	D	SD
3. Using technology improves my performance.	SA	A	N	D	SD
4. Using technology saves me time.	SA	A	N	D	SD
5. Using technology allows me to accomplish tasks more quickly.	SA	A	N	D	SD
6. Using technology allows me to accomplish more things than would be possible.	SA	A	N	D	SD
7. Using technology reduces the time I spend on unproductive activities.	SA	A	N	D	SD
8. Using technology enhances my effectiveness.	SA	A	N	D	SD
9. Using technology increases my productivity.	SA	A	N	D	SD
10. Overall, I find technology to be useful.	SA	A	N	D	SD

APPENDIX D: PERCEIVED EASE OF USE

The next set of questions concerns your perceived ease of use regarding technology in general. Please indicate whether you strongly agree, agree, are neutral, disagree, or strongly disagree with each statement.

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1. I often become confused when I use technology.	SA	A	N	D	SD
2. I make errors frequently when using technology.	SA	A	N	D	SD
3. Interacting with technology is often frustrating.	SA	A	N	D	SD
4. I need to consult the user manual often when using technology.	SA	A	N	D	SD
5. Interacting with technology requires a lot of mental effort.	SA	A	N	D	SD
6. I find it easy to recover from errors encountered when using technology.	SA	A	N	D	SD
7. I find it easy to get technology to do what I want it to do.	SA	A	N	D	SD
8. Technology often behaves in unexpected ways.	SA	A	N	D	SD
9. I find it cumbersome to use technology.	SA	A	N	D	SD
10. My interaction with technology is easy for me to understand.	SA	A	N	D	SD

11. It is easy for me to remember how to perform tasks using technology.	SA	A	N	D	SD
12. Overall, I find technology easy to use.	SA	A	N	D	SD

APPENDIX E: SELF-EFFICACY

The next set of questions concerns your perceptions about your competence. Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with each statement.

	STRONGLY AGREE	AGREE	NEITHER AGREE NOR DISAGREE	DISAGREE	STRONGLY DISAGREE
INITIATIVE					
1. If something looks too complicated I will not even bother to try it.	SA	A	N	D	SD
2. I avoid trying to learn new things when they look too difficult.	SA	A	N	D	SD
3. When trying to learn something new, I soon give up if I am not initially successful.	SA	A	N	D	SD
EFFORT					
4. When I make plans, I am certain I can make them work.	SA	A	N	D	SD
5. If I can't do a job the first time, I keep trying until I can.	SA	A	N	D	SD
6. When I have something unpleasant to do, I stick to it until I finish it.	SA	A	N	D	SD
7. When I decide to do something, I can go right to work on it.	SA	A	N	D	SD
8. Failure just makes me try harder.	SA	A	N	D	SD
PERSISTENCE					
9. When I set important goals for myself, I rarely achieve them.	SA	A	N	D	SD

10. I do not seem capable of dealing with most problems that come up in my life.	SA	A	N	D	SD
11. When unexpected problems occur, I don't handle them very well.	SA	A	N	D	SD
12. I feel insecure about my ability to do things.	SA	A	N	D	SD

APPENDIX F: ATTITUDES TOWARD TECHNOLOGY

The next set of questions concerns your attitudes toward technology. Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with each statement.

	STRONGLY AGREE	AGREE	NEITHER AGREE NOR DISAGREE	DISAGREE	STRONGLY DISAGREE
COMFORT					
1. I feel comfortable with technology.	SA	A	N	D	SD
2. Technology makes me nervous.	SA	A	N	D	SD
3. I don't feel confident about my ability to use a technology.	SA	A	N	D	SD
4. Technology is confusing.	SA	A	N	D	SD
5. Technology makes me feel dumb.	SA	A	N	D	SD
EFFICACY					
6. I know that if I worked hard to learn about technology I could do well.	SA	A	N	D	SD
7. Technology is *not* too complicated for me to understand.	SA	A	N	D	SD
8. I think I am the kind of person who would learn to use technology well.	SA	A	N	D	SD
9. I think I am capable of learning to use technology.	SA	A	N	D	SD
10. Given a little time and training, I know I could learn to use technology.	SA	A	N	D	SD
GENDER EQUALITY					
11. Using technology is more important for men than for women.	SA	A	N	D	SD

12. More women than men have the ability to become computer scientists.	SA	A	N	D	SD
13. Using technology is more enjoyable for men than it is for women.	SA	A	N	D	SD
14. Working with technology is more for women than for men.	SA	A	N	D	SD
15. Women can do just as well as men in learning about technology.	SA	A	N	D	SD
CONTROL					
16. Technology will never replace the need for working human beings.	SA	A	N	D	SD
17. Our world will never be completely run by technology.	SA	A	N	D	SD
18. People are smarter than technology.	SA	A	N	D	SD
19. People will always be in control of technology.	SA	A	N	D	SD
20. Soon our lives will be controlled by technology.	SA	A	N	D	SD
DEHUMANIZATION					
21. Technology turns people into just another number.	SA	A	N	D	SD
22. The use of technology is lowering our standard of living.	SA	A	N	D	SD
23. Technology controls too much of our world today.	SA	A	N	D	SD
24. Technology is making the jobs done by humans less important.	SA	A	N	D	SD
25. Technology is dehumanizing.	SA	A	N	D	SD

INTEREST					
26. Learning about technology is a worthwhile and necessary subject.	SA	A	N	D	SD
27. Reading or hearing about technology would be (is) boring.	SA	A	N	D	SD
28. I don't care to know more about technology.	SA	A	N	D	SD
29. Technology would be (is) fun to use.	SA	A	N	D	SD
30. Learning about technology is a waste of time.	SA	A	N	D	SD
UTILITY					
31. Life will be (is) harder with technology.	SA	A	N	D	SD
32. Everyone could get along just fine without technology.	SA	A	N	D	SD
33. It is *not* necessary for people to know about technology in today's society.	SA	A	N	D	SD
34. Technology is too fast.	SA	A	N	D	SD
35. Technology makes work done by people more difficult.	SA	A	N	D	SD

APPENDIX G: TECHNOLOGY ADOPTION

The next set of questions asks whether or not you use certain types of technologies in your life. Please indicate "yes" or "no" for each type of technology. If you answer yes, please answer the follow-up question inquiring how often you use that particular technology.

COMPUTER TECHNOLOGIES

1. Do you use email?
   a. No
   b. Yes
      If yes, approximately how often do you use email?
      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

2. Do you use search engines on the computer (e.g., Google or Yahoo)?
   a. No
   b. Yes
      If yes, approximately how often do you use search engines?
      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

3. Do you use instant messaging (e.g., AOL or Yahoo messenger)?
   a. No
   b. Yes
      If yes, approximately how often do you use instant messaging?
      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

4. Do you use Facebook?
   a. No
   b. Yes
      If yes, approximately how often do you use Facebook?
      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

5. Do you use Twitter?
   a. No
   b. Yes
      If yes, approximately how often do you use Twitter?

      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

6. Do you use the computer to visit shopping websites (e.g., Amazon or other online retailers)?
   a. No
   b. Yes
      If yes, approximately how often do you visit shopping websites?

      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

7. Do you use online banking?
   a. No
   b. Yes
      If yes, approximately how often do you use online banking?

      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

8. Do you blog (e.g., use Blogger or WordPress)?
   a. No
   b. Yes
      If yes, approximately how often do you use blogs?

      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

9. Do you use Skype?
   a. No
   b. Yes
      If yes, approximately how often do you use Skype?

      a. Once a day
      b. Once a week
      c. Once a month
      d. Once every few months

MISCELLANEOUS TECHNOLOGIES

10. Do you use a GPS navigation system (e.g., TomTom or Garmin)?
    a. No
    b. Yes
        If yes, approximately how often do you use a GPS navigation system?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

11. Do you use a cell phone?
    a. No
    b. Yes
        If yes, approximately how often do you use a cell phone?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

12. Do you use a smart phone?
    a. No
    b. Yes
        If yes, approximately how often do you use a smart phone?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

13. Do you use a money machine (e.g., ATM machine)?
    a. No
    b. Yes
        If yes, approximately how often do you use an ATM machine?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

14. Do you use a digital camera?
    a. No
    b. Yes
        If yes, approximately how often do you use a digital camera?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

15. Do you use a DVD player?
    a. No
    b. Yes
        If yes, approximately how often do you use a DVD player?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

16. Do you use an e-book reader (e.g., Kindle or Nook)
    a. No
    b. Yes
        If yes, approximately how often do you use an e-book reader?

        a. Once a day
        b. Once a week
        c. Once a month
        d. Once every few months

APPENDIX H: TECHNOLOGY ADOPTION PILOT TEST PROTOCOL

Location:
Today's Date:

1. Briefly describe the participants present at the pilot testing session.

2. What did participants think of the measure?

3. What suggestions or improvements did participants give related to the measure?

4. Other information identified as important that was related to using this measure with older adults.

APPENDIX I. ACCESS TO TECHNOLOGY CHECKLIST

Please circle "yes" or "no" indicating whether or not you have access to the technologies listed below where you are currently living.

TECHNOLOGIES	YES	NO
1. Do you have access to a computer?	Y	N
2. Do you have access to the Internet?	Y	N
3. Do you have access to a GPS navigation system (e.g., TomTom or Garmin)?	Y	N
4. Do you have access to a cell phone?	Y	N
5. Do you have access to a smart phone?	Y	N
6. Do you have access to a digital camera?	Y	N
7. Do you have access to a DVD player?	Y	N
8. Do you have access to an e-book reader (e.g., Kindle or Nook)?	Y	N

APPENDIX J. INTERVIEW PROTOCOL

Participant:
Today's Date:

1. Tell me a little bit about the types of technologies you currently use.
    a. Why did you begin using those technologies?
    b. How did you go about learning to use those technologies?
    c. Are there any technologies you wish you could use that you don't?
2. In what way does the usability or user-friendliness of technology influence your decision to use it?
    a. To what extent does technology need to be easy to use in order for you to use it?
    b. What types of technologies do you find to be user-friendly?
3. Can you think of an example of a time when you were successful using technology?
    a. What went well?
4. Can you think of an example of a time when you encountered difficulty using technology?
    a. What went wrong?
    b. What was difficult?
5. What was your former occupation?
    a. What types of technology (if any) were you exposed to in your workplace?
    b. What were your experiences with technology like?
6. Tell me about whether or not you think technology is beneficial to society.
    a. To what extent is it detrimental?
7. Was there anything else you would like to add that I did not ask?

APPENDIX K. INTERVIEW REFLECTION

Name of person being interviewed:
Date of interview:
Brief description of setting:
Describe general impressions from the interview:
What went well during the interview?
What was difficult about the interview?
Are there questions to add/delete/modify before the next interview?
If there anything that needs to be addressed?

APPENDIX L. IRB APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 5/30/2012

To: Melinda Heinz
96 LeBaron Hall

CC: Dr. Peter Martin
1085 Elm Hall

From: Office for Responsible Research

Title: Influences of Technology Adoption

IRB ID: 12-267

Study Review Date: 5/29/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption,** even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

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