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An examination of the acceptance, adoption, and diffusion of smartphone devices with senior citizens.

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By

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We certify that this dissertation, submitted by James Reneau, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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An Abstract of a Dissertation Proposal Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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This research looked at the process of the diffusion of an innovation in the context of smartphones with American senior citizens. The subject of diffusion, or spread of a technology, is a rich and varied topic with more than 60 years of research. Much of this diffusion research does not go beyond the study of the original acceptance of a new idea. An on-line and face-to-face questionnaire was used to collect data from 155 seniors on the entire process of diffusion. The questionnaire was adaptive in nature, focusing questions directly at participants based on where they were in the diffusion process.

The scope of the study was limited to two areas: 1) to verify or refute the findings of the Senior Technology Acceptance & Adoption Model (STAM) in the setting of a more diverse population of seniors and the different technology of modern smartphones than the original small population of South African seniors using mobile-phones and 2) to look at the phenomenon of discontinuance of use after adoption.

The results show that seniors exhibit a much broader range of influences, behaviors, and motivations than the STAM model showed. Confirmed usefulness, ease of use, and other facilitating conditions play a significant role in how a technology moved from mere use to either being fully accepted or finally rejected. This research adds to the body of knowledge regarding the diffusion of technology, specifically adoption in seniors. Many existing models did not include the complete process by shortening the initial exploration and ignoring the discontinuance. These issues have been specifically addressed in a newly proposed model, the Senior Innovation Domestication and Life-cycle Model (SIDLM).

Acknowledgments

In my life gratitude is an action word. To be truly grateful for the good things and people in your life you have to work to share them and nurture them. Education and a lifetime of learning are two things I am grateful for and I hope to share them with my students for a long time to come.

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Introduction

Background

Senior citizens have been slower to accept smartphones as the primary mobile communication device into their daily lives than the rest of the adult population in the United States (Smith, 2011). This research looked at the acceptance, adoption, and diffusion of this technology in their lives. Technology diffusion, with seniors, was investigated using a questionnaire to show the validity of the Senior Technology Acceptance & Adoption Model (STAM) (Renaud & van Biljon, 2008). In addition to testing the validity of the STAM, this research looked at the diffusion of an evolving technology in a dynamic population and makes recommendations for changes to the STAM. These changes included adding influences as observed; adding a process of actual acquisition of a smartphone, and adding processes to understand the confirmation and examination of a user's original decision to reject or accept a technology.

In a May 2011 survey of American adults (n=2,277), it was found that 35% of respondents stated that they had a smartphone. The adoption rate of seniors (11%, n=637) was significantly lower than that of adults aged 30-49

Chapter 1

Introduction

Background

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In a May 2011 survey of American adults (n=2,277), it was found that 35% of respondents stated that they had a smartphone. The adoption rate of seniors (11%, n=637) was significantly lower than that of adults aged 30-49

(45%, n=581) (Smith, 2011). This difference is indicative of the widely accepted "generation-gap" in the access and use of digital technology (van Dijk, 2005).

Problem Statement

The literature on the acceptance and diffusion of technology is a rich and varied topic that has been researched for more than 60 years. A vast majority of this research has been on the positive aspects and not on the unintended or undesirable consequences of the diffusion of innovations (Sveiby, Gripenberg, Segercrantz, Eriksson, & Aminoff, 2009). This pro-innovation bias has permeated the current research and has created a rather myopic belief that the use of technological advances are usually, if not always, better than prior ways of accomplishing the same task (Rogers, 2003).

In many of the current technology acceptance models, the subsequent discontinuance of use of a technology after the initial adoption is not integrated into them (Davis, Bagozzi, & Warshaw, 1989; van der Heijden, 2004; Venkatesh, Morris, Davis, & Davis, 2003; Renaud & van Biljon, 2008). These models, that permeate the research on technology adoption and diffusion, may lead researchers and developers into a belief that diffusion should always be faster rather than

slower, that adoption should be by all members of the social group, and that discontinuance of use should not be happening (Rogers, 2003).

This research looked at the specific social group of American senior citizens, aged 65 or older, and diffusion of a current technology (smartphones). Each of the 155 qualified participants were asked to complete a questionnaire about their knowledge and use of smartphones. Additional questions were also asked to the seniors that have decided against adopting the technology and those who have discontinued usage of the devices. All participants were finally asked questions to gain an understanding of the social and other influences upon their decision making process.

Specifically this research sought to validate the STAM (Renaud & van Biljon, 2008) in relation to a population and technology that was different than the original population and technology used to originally create the model. This research also goes on to show a need for significant changes to the STAM to account for behaviors seen in this research's collected data that extend it to include the initial acquisition of a technology and the decision to stop using a technology after they initially accepted and/or adopted the innovation.

This research, while focused on the STAM and American senior citizens, adds to the current understanding of how technology is diffused. The recommended changes to the STAM need to be studied in the context of other

populations, technologies, and models to see if similar recommendations need to be made to gain a better understanding of the entire diffusion life-cycle.

Dissertation Goal

The original goal of this research was to gain a better understanding of the STAM (Renaud & van Biljon, 2008) by testing the fit of that technology diffusion model in the context of American seniors. It was through this analysis of the entire cycle of diffusion of smartphones and associated technologies with seniors that this research shows the STAM is indeed a generalizable model to understand the adoption of new technologies in seniors. With the caveat that minor changes need to be made to STAM to better understand the process once a decision to use is made, this research's initial goal was incomplete. After measuring and analyzing responses of 155 American seniors who are at different places throughout the diffusion process of smartphones, many changes throughout the STAM are suggested, both for the anticipated discontinuance and for other factors.

Research Questions

The following research questions guided the research.

RQ1

The STAM describes a model explaining the diffusion of mobile-phones in a population of South African seniors (Renaud & van Biljon, 2008). By relating acceptance factors to adoption stages, STAM provides an explanation as to why many elderly adults never reach the final adoption phase and never fully accept the technology. Research question number one will determine if the STAM is a valid and representative model to study technology use by seniors, particularly their adoption of smartphones in a diverse and different population (U.S. centric).

RQ2

The STAM does not explicitly address the discontinuance of use of a technology after it has been adopted. In the Innovation Diffusion Theory (IDT) (Rogers, 2003) there is a fifth phase called "confirmation" where adopters or rejecters of a technology examine their prior decision and may change their mind

based upon their current perceptions. Research question number two will see if the phenomenon of conformation and reexamination of a previous decision occurs in the research population and can it be modeled by expanding upon the STAM.

Relevance and Significance

This section discusses why this research is important by answering several questions. These questions include: (a) why the problem exists, (b) the potential benefits of solving the problem, and (c) and how this will add to the technology diffusion body of knowledge.

Why is There a Problem?

Going back to the beginning of diffusion research, there has been a significant pro-innovation bias in much of the work that has been done in the field (Rogers, 2003; Sveiby et al., 2009). This bias has been the consequence of influence by funding sources (both governmental and industry), by the focusing on successful and rapid diffusions, and by researchers selecting innovations that "look intellectually interesting" (Rogers, 2003, p. 111). This bias has influenced research in three significant ways: 1) much more research has been done and

more written about rapid and successful diffusions; 2) more study has been done about acceptance rather than rejection of new technology; and 3) many researchers do not have a complete understanding of why technologies are discontinued (Rogers, 2003).

In addition to the pro-innovation bias as seen in many of the existing models, the population of seniors may also pose unique problems. Seniors have a special place in the social fabric of their communities and their role in that community is changing. After decades with families, spouses, and work roles that attached them directly to so many people and institutions, this loss of connectedness can cause isolation and disengagement from society and the changes within their community (Itzin, 1970).

This research used the context of a rapid and successful diffusion of a technology to probe more deeply into how American seniors decide to adopt a new technology. Additional questions were asked to eliminate the pro-innovation bias by looking for the rare but observable rejection and discontinuance of use. Questions were also directed to understand the importance of family, friends, and the media in the diffusion of a new technology.

What are the Benefits of Solving the Problem?

The pro-innovation bias, even though it may be justified, keeps researchers from fully understanding the motivation and real needs of end users (Rogers, 2003). In the context of this research, the primary benefit is the suggested adjustment of the STAM to highlight the motivation of seniors when they decide to stop using an innovation in general and smartphones in specific.

More than 40 years ago, the roles of seniors was understood to be very different from younger people. Senior citizen's leisure activities, available time, financial situation, and social role are changing in society. Children and grand-children become advisors, isolation and fear may separate seniors from their communities, and physical and mental changes are reshaping the world older people live in (Itzin, 1970). These changes are continuing to evolve as more seniors are working into their 70s and their health continues to improve ("Study highlights the role of seniors," 2007). With the dynamic nature of an aging population, technological diffusion models must be refined and targeted to address the specific needs and changing natures of seniors.

In a more general sense, beyond the diffusion of smartphones, this change will remind and encourage future researchers to ask the probing "why" questions in the diffusion of other technologies with seniors. Another benefit of this research is to remind future researchers that the decision to adopt a technology is

not a terminal one and to make changes to the STAM to reflect the dynamic reality of technology adoption.

How Will This Research Add to the Knowledge Base?

There are several areas in which this research adds to the current state of knowledge. These areas include: (a) the validation of the STAM in the context of American seniors, (b) changes to the STAM to model the discontinuance of use or the desire to reexamine the initial decision to adopt, and (c) addition to the currently sparse literature on what happens after initial diffusion.

The STAM was originally created based on a study of South-African seniors with the diffusion of plain mobile phones, not smartphones (Renaud & van Biljon, 2008). Based upon the data collected and analyzed in this research it does appear that the STAM applies to the observed population of American seniors, as it did in the original study group.

While STAM, is valid to a point, three of the participants who completed the survey said that they previously used a smartphone, but do not currently have or use one. These individuals, almost 2% of the study population, do not fit into the STAM as there is no path from *Actual Use* and *Acceptance* to *Rejection*. STAM also does not account for the individual who at one point has rejected an innovation but then later reexamines their decision, in the light of new external

influences. This research makes these additions with the hope that the changes to STAM will help to make the model more generalizable in the senior community.

The heightened awareness of the phenomena of discontinuance after adoption of an innovation is the third, and probably the most important area of knowledge, that this research will add to. There has been much work in the field of diffusion but the research of why a technology is rejected subsequent to adoption has not had the same level of research (Rogers, 2003; Sveiby et al., 2009). This huge gap in the research that exists will not be filled by this single dissertation, but any new work will hopefully remind future researchers of the pro-innovation and other biases they may have. This is of vital importance not only to seniors and the STAM but to diffusion research with all groups.

Definition of Terms

Defining who qualifies as a senior citizen is complicated, as there are many definitions. The definition of a senior citizen that guides this research is that they are "an old age pensioner" ("senior citizen," n.d.). In the U.S., there is not a single national retirement or pension age, but a majority of older Americans qualify for medical coverage under Medicare when they attain age 65 ("Getting Medicare before you get your Full Social Security Retirement Benefits," 2008).

Medicare eligibility is a national rite-of-passage in the life of an aging individual. The original STAM research used South African seniors aged 60 and over (Renaud & van Biljon, 2008). This research used the criteria of age 65 or older as the objective measure of whether an individual is a senior citizen.

Throughout this report, the term "technology" is used. It can best be defined as "a design for an instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (Rogers, 2003, p. 13). It is defined elsewhere as the "use of scientific knowledge to solve practical problems" ("technology," n.d.). Rogers' definition helps to explain why individuals ask questions about the perceived value of an innovation and not only look at technology for technology's sake. A good definition of technology is: a method or device (or both) that reduces the chances of failure in performing a task (Rogers, 2003).

Diffusion, especially in the context of this research, is used to describe the spread of information about a technology and the dispersion of the technology into general use. The process of diffusion is made up of four components: 1) communication about an innovation or technology; 2) a communication channel or channels to distribute this information; 3) a time frame for the communication; and 4) a social group or system having the communication. (Rogers, 2003)

Summary

The topic of technology diffusion has been studied by researchers over decades. Many models, including several very specialized ones, have been created to help describe the acceptance and use of technologies. This research looked at a specific model that was focused on the adoption of technologies by seniors, the STAM, and tested it for validity with American seniors in the context of a different technology. Additionally, this research looked at the process of discontinuance of use caused by the continual reexamination of a previous decision to adopt, as predicted by the IDT.

The research was grounded in prior diffusion research, as discussed in Chapter 2. The questionnaire used and the on-line and face-to-face delivery method for delivery is described in Chapter 3. A summary of the results of the responses of 155 American seniors is included in Chapter 4, and in Chapter 5 significant modifications and additions to the STAM are recommended and a new model for describing technology adoption is proposed. This research adds to the body of knowledge about technology diffusion and specifically to the way seniors approach, adopt, and subsequently discontinue use of an innovation.

Chapter 2

Review of Literature

Overview

Historically seniors, as their lives and daily situations change, often experience a lack of social interaction (Itzin, 1970). This isolation can be moderated through the use of social media and e-mail. The adoption of this technology is being slowed by many seniors' apprehension toward the technology and vendors'/designers' lack of attention to the special needs of this population (McMurtrey, McGaughey, Downey, & Zeltmann, 2010). The diffusion may also be slowed by a deficiency of direct communication about the possible benefits of the technology.

Technology Diffusion and Acceptance

Extensive research has been done to attempt to model the diffusion, adoption, and acceptance of technological innovations (Davis, 1989; Renaud & van Biljon, 2008; Rogers, 2003; Silverstone & Haddon, 1996; Venkatesh et al.,

2003). There appears to be no single perfect model to predict a person's willingness to use a new technology. Even harder to understand is the mechanism of how an innovation is fully adopted in a social system. Most of the existing models, of which several are discussed below, were created to describe a general population, while a few of them are targeted at a specific class of individuals.

Innovation Diffusion Theory (IDT)

The Innovation Diffusion Theory (IDT) was originally described in 1962 to model the diffusion of agricultural innovations. Over the decades it has been applied to general technology diffusion and has been used as the basis for much of the research in technology diffusion (Davis et al., 1989; Renaud & van Biljon, 2008; Venkatesh et al., 2003).

A technology needs to be seen as creating an advantage, in some aspect, before it will be adopted. Additionally, no matter how good the innovation is, it needs to be communicated to potential users in a positive light. This process of communicating the advantages of an innovation between members of a social group, over a period, is known in the literature as *diffusion* (Rogers, 2003). A social group with communication can be as small as a single family discussing a technology over the dinner table or as large as the entire global community sharing ideas advertised through the mass media.

The IDT describes a five phase diffusion process, they are: 1) knowledge, 2) persuasion, 3) decision, 4) implementation, and 5) confirmation. Knowledge, typically gained through the mass media, is where a person learns of the existence of an innovation and what it is/does. In the persuasion phase, a person reduces the uncertainty of a technology by exploring and measuring the advantages and disadvantages in their personal context. In the decision phase, a person goes through the activities that culminate in a choice either to adopt a technology or to reject it. Implementation is the activity of initial use where the user changes their patterns to better utilize the innovation or changes the innovation, through a reinvention process, to better fit into their daily activities. Finally, confirmation is the process of strengthening or weakening the original decision made in phase three. (Rogers, 2003)

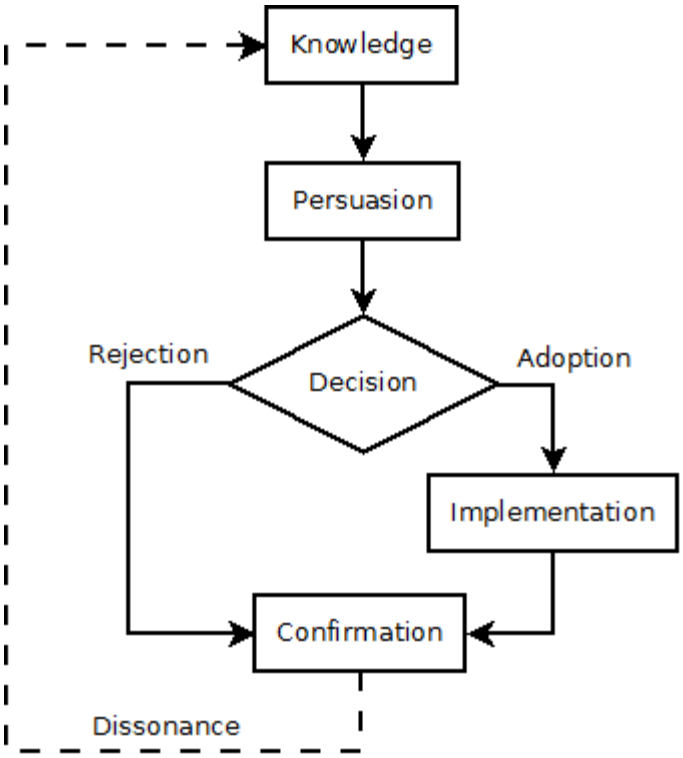

Figure 1: The Five Phases of the IDT

Typically the five phases of the IDT are drawn in a straight line or waterfall to represent them as discrete points that a person passes through as they progress into adoption. Rogers (2003) describes each of the five phases in great detail and an important and often overlooked detail of the decision phase is that a person who rejected an innovation also enters the confirmation phase. During confirmation an individual will continue to look at an innovation and gather additional information from their social group and from their personal experience with or without the technology. This pressure of new information and experience

may cause an individual discomfort about their previous decision and cause them to reexamine their behavior. This state of irritation about a previous decision is known, in much of the research, as dissonance (Rogers, 2003).

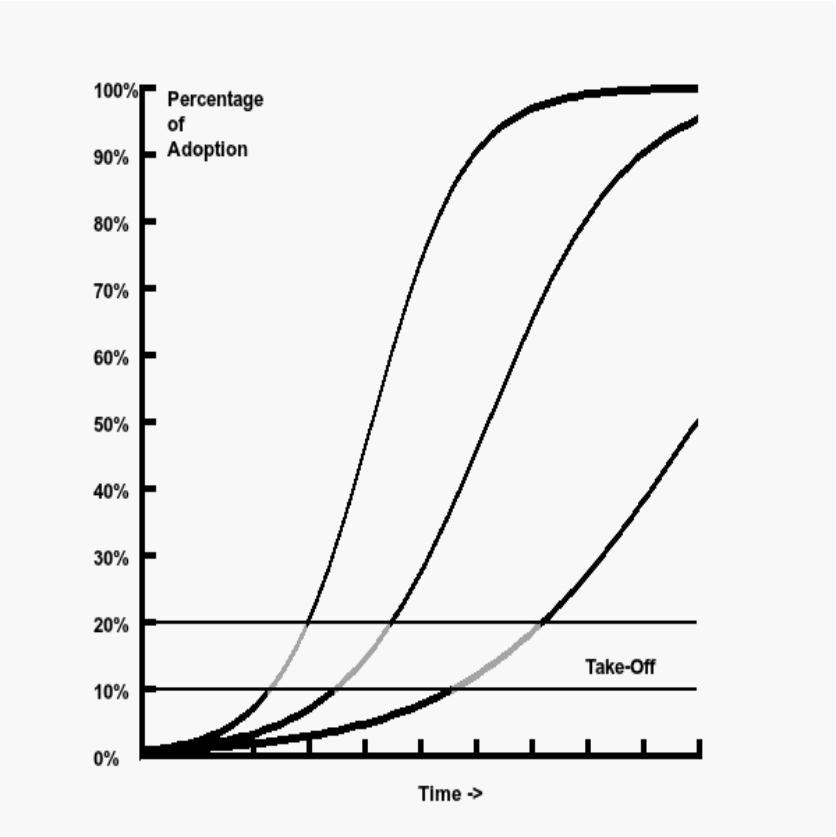

Figure 2: Diffusion of Innovation Curve (Rogers, 2003)

The rate of adoption of a new technology typically follows an "S Curve" with one axis representing the saturation percentage in the population and the

other axis representing time. The Perl Curve (Equation 1) is a commonly used mathematical expression to represent and describe this type of behavior (Co, 1999).

$$y = \frac{L}{1 + Ae^{-Bt}}$$

Equation 1: The Perl Curve

It has been seen that, typically, once an innovation has reached a saturation point of 10 to 20% of a social group the innovation begins to diffuse on its own accord, this is called the "take-off". Take-off may occur because the uncertainty of usefulness is diminished as the invention becomes accepted into the social framework, as users get a chance to give it a try, and as the technology becomes more visible in their lives (Rogers, 2003).

Rogers (2003) also discussed the need of researchers in this field to be cognizant of their potential to a pro-technology bias when trying to understand diffusion. He believes that this bias is a direct result of influence by change agencies and that the diffusion of successful technologies leave an easily accessible body of knowledge for researchers to study. Several strategies are covered to overcome the tendency to this biased view. They include but are not limited to: a) research earlier in the diffusion process; b) questioning the innovation's inevitable success; c) looking at the broader context of the innovation

in the context of the social group; and d) research to understand individuals' motivations for adoption, rejection, and reinvention of an innovation.

Technology Acceptance Model (TAM)

In a group of studies dating back many decades (Davis, 1989), it was shown that an individual's self-reported usefulness of a software system correlated very strongly to the same individuals saying that they would use the software if it were available to them. Ease of use was also found to correlate significantly to current use and self-predicted future usage, but it was not as strongly correlated as usefulness.

Using these findings and other sources of research, Davis developed the Technology Acceptance Model (TAM). This model as shown and validated states that a user's Behavioral Intent (BI) to use a system is a direct combination of their Attitude (A) toward using the system and their perception of Usefulness (U) of that system (Davis et al., 1989).

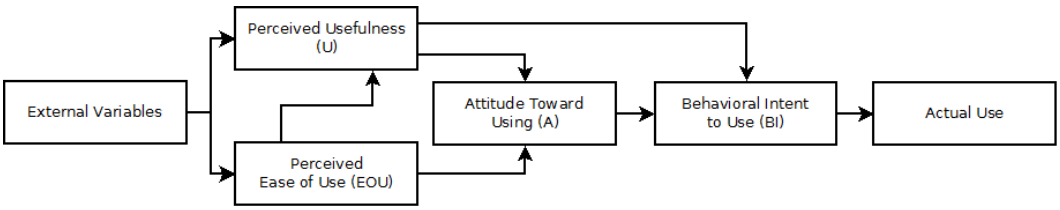

Figure 3: Technology Acceptance Model – TAM (Davis et al., 1989)

A limitation of the TAM is that it only looked at an organizational usage of technology. External forces like: employer and supervisor demands, feelings of other co-workers, and personal performance in the workplace have a driving effect on the entire model (Davis et al., 1989). This authoritarian requirement to use a technology, the pressures from a social group, and one's own personal motivations are also described and predicted by the earlier works of Rogers (2003).

When the desire to use a system is for self indulgence or entertainment of the user, the TAM has been shown to break down. After surveying hedonistic users of a computer system it was found that usefulness was not as strongly correlated to predicted future use as ease and pleasure derived by the usage (van der Heijden, 2004). This points to an important difference between technology systems used for pleasure and those used solely for functionality. Van der Heijden goes on to suggest that "if people reject a utilitarian system, system developers may want to add hedonic features" (2004, p. 701). Seniors typically have less restrictions on them from an external organization than most adults.

Unified Theory of Acceptance and Use of Technology (UTAUT)

In an attempt to create a more universal technology adoption model, the Unified Theory of Acceptance and Use of Technology (UTAUT) was created.

The UTAUT describes how usage is influenced by four determinants that describe the user's intent, tempered by four different demographic and environmental factors (Venkatesh et al., 2003). This model was developed by merging eight different technology use models into a single descriptive model. They are: 1) Theory of Reasoned Action; 2) the TAM; 3) the Motivational Model; 4) the Theory of Planned Behavior; 5) a model combining the TAM and the Theory of Planned Behavior 6) the Model of PC Utilization; 7) the IDT; and 8) the Social Cognitive Theory (Venkatesh et al., 2003, p. 425).

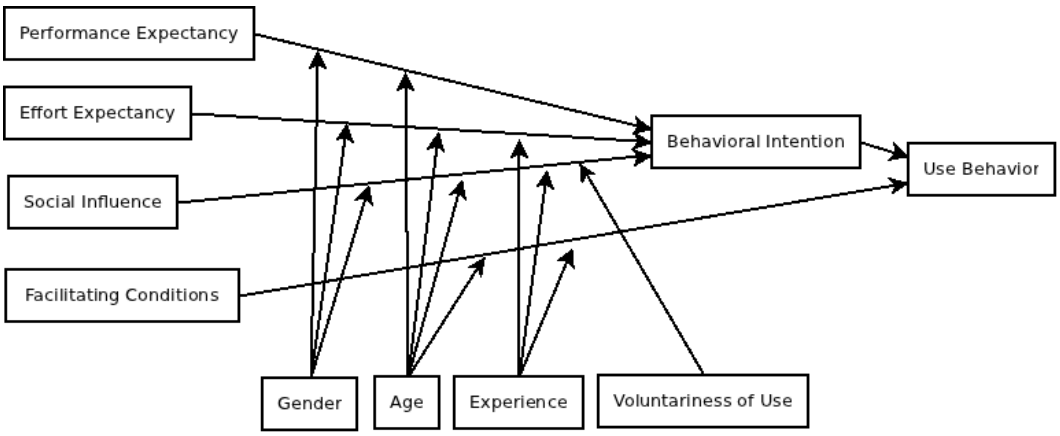

Figure 4: Unified Theory of Acceptance and Use of Technology – UTAUT (Venkatesh et al., 2003)

The UTAUT model described much of the variation in the user's intent to use a technology and appeared to do a better job than any one of the theories that

were used in the creation (Venkatesh et al., 2003). The ability to generalize this model to a more inclusive population, from the corporate environment where it was developed and tested, has not been shown.

The Domestication of Information and Communication Technologies

Another way to look at the diffusion process was proposed in the Domestication of Technology (DOT) model (Silverstone & Haddon, 1996). This process looks more closely at the connections and feedback between the engineering (design) of a process or an item and the actual adoption and use of the innovation (domestication). This connection happens through commodification in the marketplace. In the marketplace, it can be seen that domestication of an innovation is the direct product of a complete design and that the design is only realized by it being domesticated. This connection is like the two sides of a single coin.

The design of an object or innovation begins with actually *creating the artifact*. This is the original definition of the form and function of the technology. In the early life of the artifact it is an oddity to be admired, but as it matures it becomes a part of everyday life and looks toward the future innovations. Once the artifact is created the process of *constructing the user* begins. Images of potential users, their abilities, desires, and limitations are included in the design.

This includes limitations to the capability of the artifact to make it more compatible with the prospective user. An example of the design limitation may be the size of a smartphone screen, it could be several feet across in measure but it would be unusable in the context of a portable and pocket sized device. The third part of design is *catching the consumer*. This is including the historical context of familiar technologies in an innovation so the future customer has a point of reference and connection to the technology. An example would be the red and green call buttons on an old mobile phone that are seen drawn on the screens of modern smartphones. The designers could have chosen a different paradigm but looking back at the previous technology made the touch screen innovation more palatable.

The domestication of an innovation begins when a potential user hears and starts to think about it. The domestication process goes through four phases: 1) *appropriation*, 2) *objectification*, 3) *incorporation*, and 4) *conversion*. In the *appropriation* phase of domestication the user finds out how to get information about an innovation, discovers how to get it, may experiment with it, and subsequently brings it home. This is followed by *objectification* where the user asks how it will be used, how it will be stored, and where it will be kept. The innovation is a thing at this point, it has not been integrated into the life of the user. The third phase is *incorporation*. During incorporation a user actually uses the innovation. There is regular interaction, exploration, and learning about the

features of the design and how the design will fit into the user's context. Once a technology is incorporated a user will start to apply a status of importance to the technology or device, this is *conversion*. A domesticated user, through conversion, will also signal to others in their social group this importance and the need for them to consider this innovation.

Senior Technology Acceptance & Adoption Model (STAM)

Renaud and van Biljon (2008) proposed a new model called the Senior Technology Acceptance & Adoption Model (STAM) for understanding rejection, actual use, and the acceptance of a technology in a senior population. The STAM differs greatly from the TAM because this model ends with the full adoption of a technology and not just actual use of it. Another way this model is different is that external social influence is also included in the process. The STAM also uses a general structure similar to the one in the DOT model and departs from the IDT.

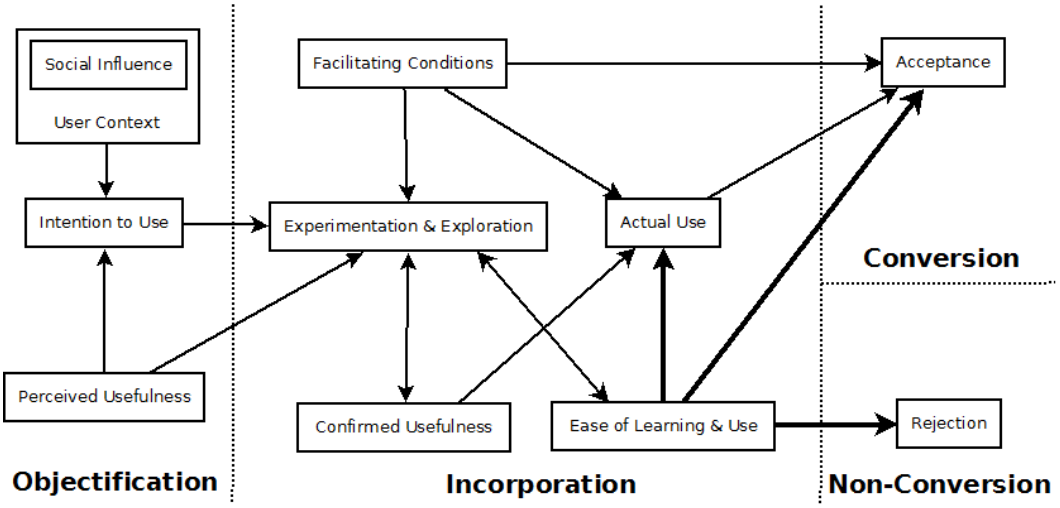

Figure 5: Senior Technology Acceptance & Adoption Model - STAM (Renaud & van Biljon, 2008)

The STAM is divided into four major phases, they are: 1) *objectification*, 2) *incorporation*, 3) *conversion*, and 4) *non-conversion*. In the *objectification* phase (phase one) a person's "user context" (made up of employer pressures, social pressures, ability, and other personal factors) along with a perception that the technology may be useful drives the individual to an intention to try an innovation. In the second phase, *incorporation*, the user experiments with the technology and is moved to actual use through a combination of outside pressures (facilitating conditions), confirming the usefulness, and ease of use. The user may move from *incorporation* to either the *conversion* phase or the *non-conversion* phase. The most significant factor in this move is the ease of use of the technology, as shown by the bold arrows in Figure 5. In *conversion* (phase

three) the individual has accepted the technological innovation into their personal and daily activities and have become a regular user. In the *non-conversion* phase an individual has moved to reject the technology and is not actually using the technology.

The concept of acceptance is a full embracing of a technological innovation and includes more than regular use. It may include a concept known as "reinvention". Reinvention occurs when a user self innovates with a technology to use it in a way that was not originally communicated or described by the social group (Rogers, 2003). The user develops their own unique and new to them version or configuration of the technology and uses it in an innovative and self-discovered way.

Abraham Maslow's long standing theory of the hierarchy of needs suggests that every human is motivated by the same desires for physiological comfort, safety, love and belonging, esteem (both internal and external) and self-actualization (Maslow, 1970). Even though STAM was originally used to describe diffusion in a population of South-African seniors, the ubiquity of base human needs should allow the model to be equally applicable to other populations.

There are a few potential issues with the original research that was used to create the STAM. Only a limited population of seniors (n=34) was interviewed using a semi-structured questionnaire. All of the participants were using mobile

phones in some manner and almost half of the individuals interviewed were between the ages of 70 and 80 ($n_{70\text{-}80} = 16$). In addition to the small sample size, the racial and economic status of these South African seniors was not collected or reported.

A limitation found in almost all of the technology acceptance models discussed in the review (Davis et al., 1989; Davis, 1989; van der Heijden, 2004; Venkatesh et al., 2003) was that technology acceptance is a binary conclusion. With the complexity of modern systems, it is difficult to make such an absolute decision. A user may be a "power user" of some features and totally ignore other common features. The STAM only included two categories of usage: 1) adoption (actual use); and 2) acceptance (Renaud & van Biljon, 2008). In a separate study with seniors and regular mobile phones that did not explicitly offer a model for technology acceptance, three clusters of users were identified: 1) explorers; 2) basicians; and 3) minimalists (Lee, 2007).

Questionnaires and Data Collection

Several different methods have been used to collect the data used to explore technology acceptance and adoption. Four of these methods, using questionnaires, can be described as: 1) Davis's (1989) single questionnaire; 2)

Kurniawan et al., and Mahmud's (2006) start with a focus group and expand to a questionnaire; 3) Renaud and van Biljon's (2008) use of a semistructured interview, and 4) Lee's (2007) work of refining her population.

In the research used to suggest the TAM, Davis (1989) used 12 questions, with a 1-7 Likert-like scale, on a questionnaire. This survey method tried to gain an understanding, in corporate and university settings, of: 1) usefulness; 2) ease of use; and 3) if they did use or would they use the software if it were available. The four questions in each of the three areas were selected and refined from a larger list of questions. The reliability (internal consistency) of the questions were tested by calculating the Cronbach's Alpha (Equation 2) which is a ratio of the sum of the variance between the questions and the variance of the total instrument (Bland & Altman, 1997).

$$a = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum s_i^2}{s_T^2}\right)$$

Equation 2: Chronbach's Alpha

Kurniawan, et al. (2006) used a two-prong approach in trying to gain an understanding of older people's use and issues with mobile phones. They used a combination of qualitative and quantitative methods. First, a focus group was held with a total of seven participants and they were asked open-ended questions to elicit conversations about problems, benefits, and desired features in mobile phone technology. After the focus group, the researchers created a qualitative

instrument to balance and more broadly validate and understand what was learned. An on-line questionnaire with Likert-like questions was distributed and 100 seniors participated in the survey.

In the research leading to the creation of the STAM, a process of interviews were conducted with a small group (n=34) of participants that were current users of mobile phones (Renaud & van Biljon, 2008). The researchers followed a script to give the interview a structure and to collect the data. The interview was broken into four sections; 1) demographics, 2) five use scenarios, 3) questions about acceptance factors, and 4) a brief prototyping scenario. There was originally a fifth exercise where the participant was asked to recall the specific combination of button presses to accomplish certain tasks, but it was abandoned as too difficult to administer and potentially of no value. (Renaud & van Biljon, 2008)

Other research using more than one questionnaire/survey instrument reversed the order used by Kurniawan et al. (2006). Lee (2007) used a widely distributed questionnaire, in a first phase, to gain an understanding of usage, quality, and how they acquired the technology. In a second phase, she selected a small group of representative respondents and interviewed them to collect usage stories, discuss barriers to technology, and provide recommendations for future change.

Summary

As seen in this literature review, there are many models for describing technology diffusion. Origins for much of this work can be dated back to the 1950s and were originally used to describe the adoption of agricultural innovations (Rogers, 2003). New technology and the understanding that various populations of individuals react in a different manner have necessitated the need for more research and refinement of the original models.

Chapter 3

Methodology

Overview

The research questions that drove this work attempt to answer: 1) if the STAM is a valid and representative model to study technology use by American seniors with a different technology than was used to originally define the model; and 2) if the phenomena of discontinuance does occur and needs to be added to the STAM. The methodology used to answer these research questions was to survey American seniors about their motivations, adoption, and use of smartphones. Data collection was accomplished using a computer-based questionnaire with adaptive delivery of sections to specifically address where a participant is on the diffusion curve. The actual delivery was completed independently on-line and face-to-face with senior citizen groups.

Methodology

Several questions were asked during the development of the survey instrument used in this research. These questions were: (Groves et al., 2009)

1. What target population is being studied?
2. What specific properties can be used to identify that an individual could be included in the survey (sampling frame)?
3. If the sampling frame is too large to survey all members how will the final sample be selected?
4. How will the data be collected?
5. Will the survey be of a limited or unlimited duration.

The "sampling frame" for this research was defined as an individual living in a U.S. state or territory who is 65 years old or older. The first two questions of the survey asked a participant their age and residency. The questionnaire delivery software automatically limited participation to only those individuals who self-identified into the desired group.

With the U.S. senior population exceeding 40 million individuals aged 65 or older (Werner, 2011), it would be impossible to survey all of them. Some type of sampling process will be required. A true random sampling would not have been possible because of the voluntary nature of this research and the difficulty of

getting an accurate listing. This research used a convenience sampling of seniors to complete the questionnaire (Appendix A).

The initial participants were identified by face-to-face, email, and social media solicitation of contacts of the researcher. A personal appeal to be a participant or to suggest participation of friends and family was made. A total of 42 participants of the 155 responses collected were received this way. The remaining 113 participants were approached one-on-one in senior citizens' centers and in a local senior outreach program. All of the face-to-face participation was collected in the Kentucky counties or Greenup, Boyd, Lawrence, Carter, and Elliot and in the Ohio county of Scioto.

The questionnaire was made available on-line until 155 valid and complete responses were collected. The target minimum survey size was calculated at 150 responses. This target survey size was estimated by identifying a reasonable acceptable error of 5% (e), a confidence of 95% (1.96) ($Z_{\alpha/2}$), and an estimation of the standard deviation of (S) for a population. With these, a sample size can be calculated by solving the Confidence Interval equation (below) for n, where the population size is represented by N and satisfying the acceptable error (Lohr, 2010).

$$e = Z_{\alpha/2}\sqrt{1-\frac{n}{N}}\frac{S}{\sqrt{(n)}}$$

Equation 3: Confidence Interval

According to Lohr (2010), when a single proportion of a population is of great interest to the researchers it is often advisable to find a sampling size that reflects the desired error and confidence on that ratio ($\hat{p}$). A common estimation for the standard deviation of a binomial probability for large populations can be found using $S^2 \approx \hat{p}(1-\hat{p})$. Combining the two formulas for a large population and solving for sample size (n), a simplified sample size formula is created.

$$n = \frac{Z_{\alpha/2}^2 \hat{p}(1-\hat{p})}{e^2}$$

Equation 4: Sample Size

Using the sample size formula and the proportion that 11% of U.S. seniors have smartphones (Smith, 2011), the target minimum was calculated. Additionally by solving the sample size formula for confidence ($Z_{\alpha/2}$), given the actual sample size of $n = 155$, a confidence percentage of 95.3% is derived.

The questionnaire (Appendix A) was delivered using the Limesurvey software system. The Limesurvey is a free, open-source, server-based, and Web browser presented system for development of surveys, questionnaires, and other applications that require users to fill in data and respond to questions (*Limesurvey*,

2013). A computer-based survey mechanism was selected because of the complexity of the survey used. The survey asked a series of focused questions to individuals in each of the five categories: 1) those with little or no knowledge about the technology; 2) those who had looked into the technology; 3) those that had decided against adoption; 4) those that were current users and 5) lastly those that had discontinued usage.

It was a concern that the Web browser and on-line delivery may bias the results by skewing the participation towards individuals who are more technologically proficient. This risk was accepted and was not a significant factor, as seen in the analyzed data.

Questionnaire

The questionnaire was distributed to a general senior population and asked basic demographic questions and the participants' knowledge and use patterns of smartphone technologies. At this point in the survey, a participant would be grouped into one of five categories based on their current knowledge and use of smartphones. These participants could be described as: 1) knowing little or nothing about the technology (NOK); 2) curious about what the technology can do for them (KNO); 3) individuals who have considered the technology but

decided against using it (REJ); 4) currently using the technology (USE); and 5) people who have used the technology in the past but have decided to discontinue the use (DIS). Each of these five types of participants map into the phases of the IDT and STAM as shown in Table 1.

The questionnaire (Appendix A) had a total of 28 questions in eight sections. Early in the questionnaire, question 4, the participants were asked to choose a "statement that best describes your use and knowledge of smartphones and their features." Based upon their selection only specific sections from the remainder of the questionnaire was presented. Participants answered 12 to 17 questions to complete the survey depending upon where they were in the adoption process. Once they had completed the survey they were asked to optionally enter their contact information for entry into the thank-you prize drawing.

Section	Questionnaire Section Title	# of Questions
1	Participant Qualifications (All Participants)	2
2	Technology (All Participants)	2
3	Objectification – Common (KNO & NOK)	4
4	Objectification – Knowledge (KNO)	2
5	Reject Innovation (REJ)	1
6	Discontinue After Previously Adopting (DIS)	5
7	Use (USE)	5
8	Demographics (All Participants)	7

Table 1: Questionnaire Sections

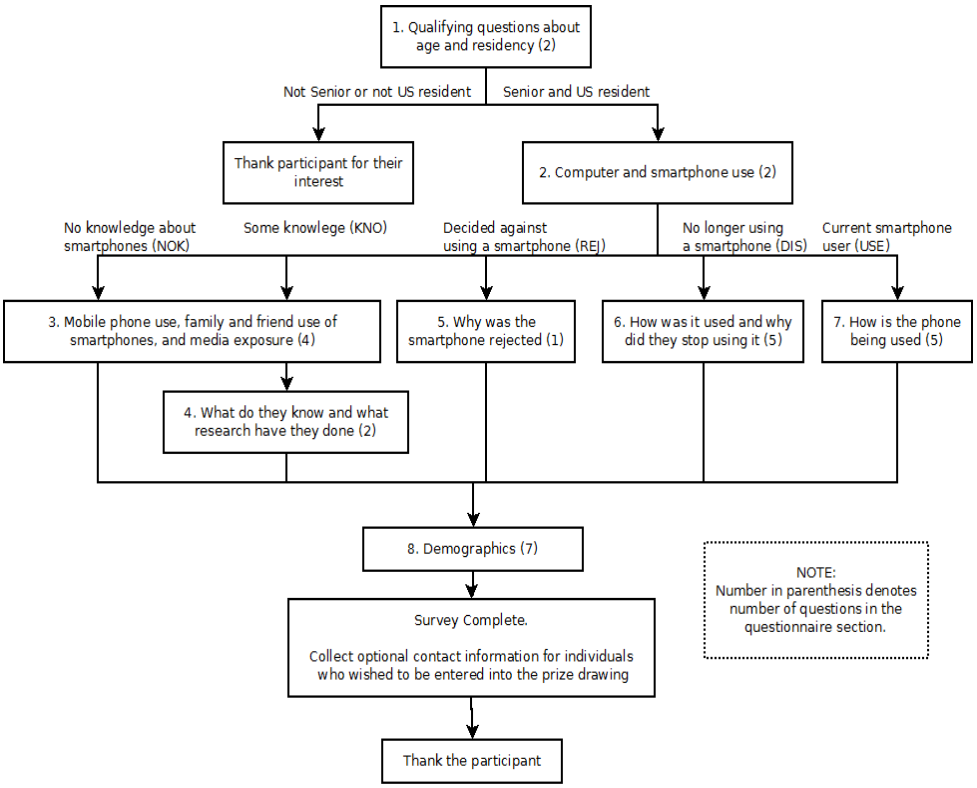

Figure 6: Flow of Questionnaire

Questionnaire Section One: Participant Qualifications

The first two questions presented asked current age and country of residence to potential participants. Individual participation was based on the answer to these two qualifying questions. Only seniors (age 65 and above) who were residents of the United States were allowed to continue. Individuals who did not meet the qualifications were taken to a Web page to thank them for their interest in the study and inform them that they do not qualify as subjects.

Questionnaire Section Two: Technology

This section was asked to all qualifying individuals and consisted of two questions. The first question in this section "How would you describe your general level of computer experience?" is taken directly from the research by Renaud and van Biljon (2008, p. 218) and was asked to gauge the participant's comfort with technology adoption in a more general context. The second question asked the participant to personally rate their level of knowledge of smartphones and their current use status. The response to the second question was used to select which of the subsequent questionnaire sections were to be delivered.

Proposed Questionnaire Sections Mapping to Phases:		
Questionnaire Section (Appendix A)	IDT	STAM
Objectification Common (3)	knowledge	objectification
Some Knowledge (4)	knowledge and persuasion	objectification
Current Use (7)	decision, implementation, and confirmation	incorporation and conversion
Reject Adoption (5)	decision and confirmation	non-conversion
No Longer Use (6)	decision, implementation, and confirmation	conversion and non-conversion

Table 2: Questionnaire Sections and Mapping to IDT and STAM

Please choose the statement that best describes your use and knowledge of smartphones and their features.	**Sections to Deliver**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
I currently have and use a smartphone - Adoption and Current Use (USE)	Y	Y					Y	Y	Y
I have had a smartphone in the past but am no longer using one - Adoption But No Longer Use (DIS)	Y	Y				Y		Y	Y
I am curious about what a smartphone can do for me and have considered getting one - Some Knowledge(KNO)	Y	Y	Y	Y				Y	Y
I know little or nothing about smartphones and their features - No Knowledge (NOK)	Y	Y	Y					Y	Y
I have looked into getting a smartphone but have decided against it - Reject Adoption (REJ)	Y	Y			Y			Y	Y

Table 3: Questionnaire Sections to Deliver to Participants

Questionnaire Section Three: Objectification (Common)

This section contained four questions that were asked to individuals who have not adopted (used) a smartphone and have not rejected use (NOK & KNO). These individuals are in the earliest phases of technology adoption. In Roger's IDT model, users at this point in adoption are said to be in either the "Knowledge" and/or "Persuasion" phases (Rogers, 2003). Individuals who are at this point in the adoption model are said to be in the "Objectification" phase of the STAM (Renaud & van Biljon, 2008). Specifically, this section asked about the current use of a non-smart mobile phone, media exposure to smartphones, smartphone usage in the participant's social group, and communication about smartphones with members of their social group.

Questionnaire Section Four: Objectification (Some Knowledge)

This section extended the questioning from section three and added two additional questions for participants who have expressed that they have some knowledge about smartphone technologies (KNO). These users, while still in the STAM's "Objectification" phase, have started to explore the possibility of adoption or are feeling significant social pressures to adopt. The IDT refers to these internal and external forces to adopt as the "Persuasion" phase (Rogers,

2003). These questions asked if the participant had personally examined a smartphone in a store or other buying situation and what were their perceptions of the usefulness of the various classes of applications that are available.

Questionnaire Section Five: Reject Innovation

Section five of the questionnaire asked only one question to individuals who have considered adoption of the smartphone technology but who have decided not to adopt (REJ). The participant was asked to pick the reasons, or to add their own reason, that most influenced their decision to not adopt the technology at the present time. These reasons were grouped into three categories in the analysis. They are: 1) technological; 2) social, and 3) financial motivations.

In the IDT, these participants have entered the "Confirmation" phase of the model, as soon as a decision was made to not adopt. As conditions change and information is gained, a user may reexamine their decision (Rogers, 2003). In the STAM these users have entered into the "Non-Conversion" phase of the model (Renaud & van Biljon, 2008) and there is no explicit path to reexamine the rejection.

Questionnaire Section Six: Discontinue After Previously Adopting

In the IDT model, once an individual makes the decision to adopt using a technology and acts upon that decision they have entered the "Confirmation" phase, just like the individual who had rejected the technology without previously adopting (Rogers, 2003). In the STAM, once a user makes the decision to actually use a technology in the "Incorporation" phase or to accept a technology in the "Conversion" phase, there is no defined path to subsequently reject or discontinue use (Renaud & van Biljon, 2008).

This section asked five questions to collect information about the motivation of these users who gave up the innovation (DIS). The participants were asked about how they used the technology, why they originally adopted the technology, what were their motivations for discontinuing use, and how long they used the innovation before discontinuing use.

Questionnaire Section Seven: Use

Section seven contained five questions and was directed to individuals who made the decision to adopt the smartphone and were presently using one in their daily lives (USE). In the STAM, these users are either in the "Actual Use" part of the "Incorporation" phase or have fully moved into "Conversion" by

accepting the technology (Renaud & van Biljon, 2008). In the IDT, these current users are in the same "Confirmation" phase as the individuals who reject or discontinue use of an innovation.

This section asked questions about the frequency of use of the various classes of applications, how long they have been using the device, how they acquired the device, and the motivations to originally adopt. They were also asked if they would make the same choice to adopt if they had to do it over today.

Questionnaire Section Eight: Demographics

It is a common questionnaire technique, recommended by several sources (Narins, 1995; "Smart Survey Design," 2011), that the collection of demographic information be completed toward the end of a survey. It is hypothesized that these questions, including ones about income and education, can be sensitive to individuals. It has been seen that if these questions are asked too close to the beginning of the questionnaire it is more likely to be aborted. The demographics section asked seven questions each with the option to not disclose the information to ascertain household income, personal education, marital status, and the size of the community where the participant lives.

Questionnaire Wrap Up

Once the questionnaire was completed, the on-line participant was taken to a page with a message expressing the gratitude of the researchers and inviting the individual to register for a drawing for an optional "Thank You" prize. The user who wished to stay anonymous could elect to not enter their information. The optional contact information was emailed to the researcher by a simple Web server script and the information was not maintained on the server.

Participants who completed the questionnaire on the researchers' laptop were not directed to the Web site but were asked if they wanted to be entered into the prize drawing. If they wished to be entered their name and contact information (usually phone number) was written on a piece of paper and stored in a folder with the researcher. For these participants the contact information was not collected electronically.

Questionnaire Presentation

The questionnaire was presented in a Web browser one section at a time. The process also allowed a participant to move back to a previous section to review and possibly change their answers. This functionality was one of the many features of the Limesurvey software system used.

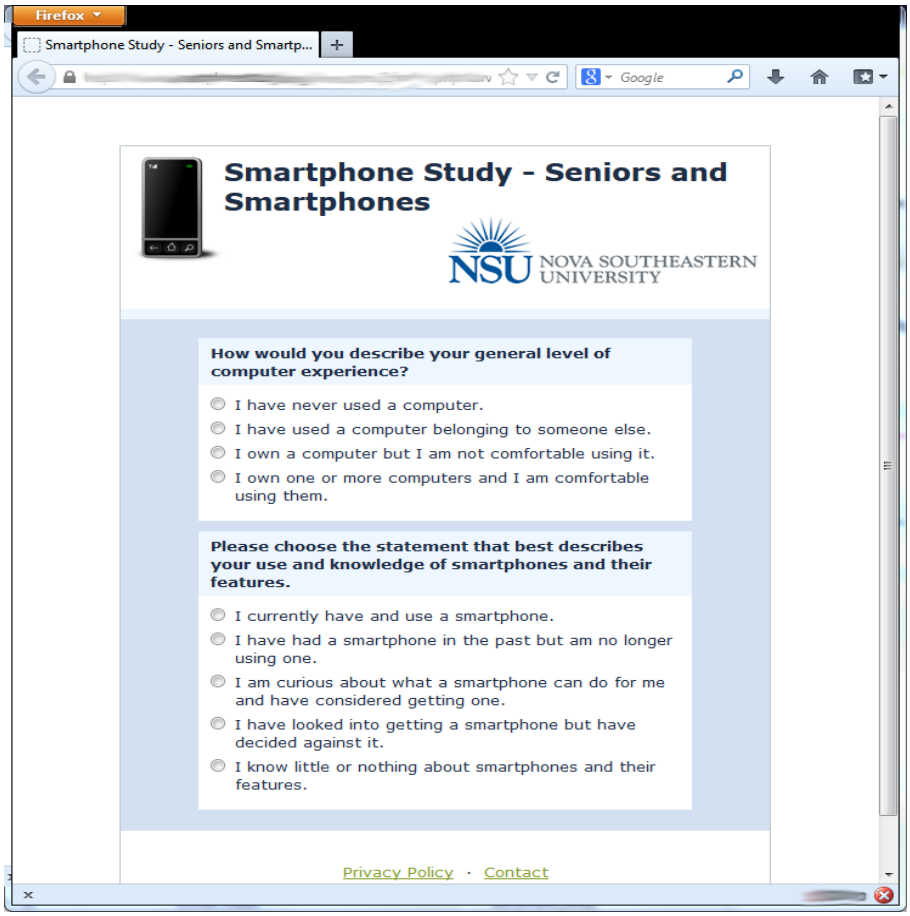

Figure 7: Questionnaire Section Two - Technology

Required Resources

Resources can be divided into two broad categories: 1) fiscal and 2) human. Fiscal resources include financial and computing resources, where human resources include the individuals that responded to the questionnaire.

The Web and database server for the on-line delivery was accomplished with a "shared hosting" account from the Web service provider GoDaddy. This hosting space was donated to the researchers by RENEJM Enterprises, Inc. The questionnaire was served using the MySQL and Limesurvey (2.00+ 130311) software applications. The Web site with introductory text and a link to the survey was created and maintained using the phpSQLiteCMS (2.04) content management system.

The off-line version of the questionnaire, that was presented on a laptop for use in the senior citizens centers, ran on an older dedicated laptop running Windows 7 Professional, the Apache HTTP server (2.4.4), PHP (5.4.12), MySQL Server (5.6), and Limesurvey (2.00+ 130311).

The tools used in the creation and delivery of the questionnaire, including: Apache HTTPD, PHP, MySQL, phpSQLiteCMS, and Limesurvey are open-source. They were licensed for this research under the GNU General Public License, the Apache License, and the PHP License. All of these licenses are approved by the Open Source Initiative's License Review Process (Open Source Initiative, n.d.).

The human resource of participants was initially found by emails to individuals associated with the researcher and by social media posts asking for help with this research. Additional participants were found by soliciting responses in area senior centers and senior organizations.

Summary

The objectives of this study were to gain a current view of the technology adoption of American senior citizens and smartphones and to test the two research questions against this collected data. This was accomplished by surveying 155 American seniors about their knowledge and use patterns of smartphones. This research goes beyond much of the previous research into adoption of technology by specifically looking at the process of reexamination of the initial decision to adopt and the subsequent discontinuance of use.

Chapter 4

Results

The results, as summarized in this chapter, show that there is a large variety of experiences in the senior community regarding technology diffusion. The population sampled in this research consisted of 155 economically, educationally, and chronologically varied individuals. Their experiences with smartphones are summarized in the Data Analysis which is divided into four sections: 1) individuals with little or some knowledge; 2) individuals who have rejected the technology; 3) current users; and 4)individuals who have discontinued use. Each of these sections describe the findings of one or more categories of participants as described in the Methodology chapter.

The Sample

The sample for this research consisted of a volunteer sample of American adults aged 65 and older. Their responses were collected through on-line solicitation and questionnaire and in face-to-face situations. The participants reported residences in seven states with Kentucky being the residence of a

majority (68%, n=106) of participants. A minority of responses (27%, n=42) of them were collected on-line and the remaining 113 were collected face-to-face with seniors, as shown in Figure 8.

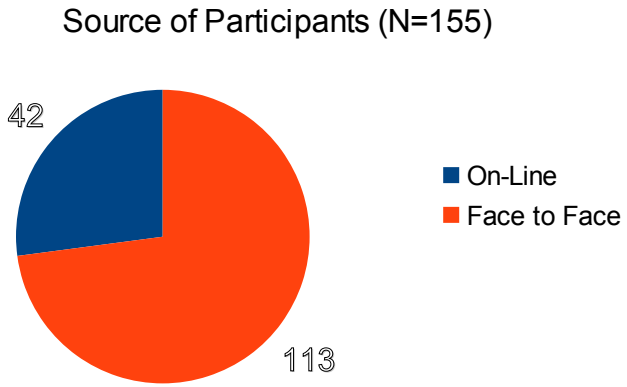

Figure 8: Source of Participants

The participants in this research were weighted more female (61%, n=94) than male (39%, n=61). According to the 2010 U.S. census of the adult population 65 and older a similar ratio is seen in the general public, 56.9% female versus 43.1% male (Werner, 2011), so this phenomenon is not unexpected.

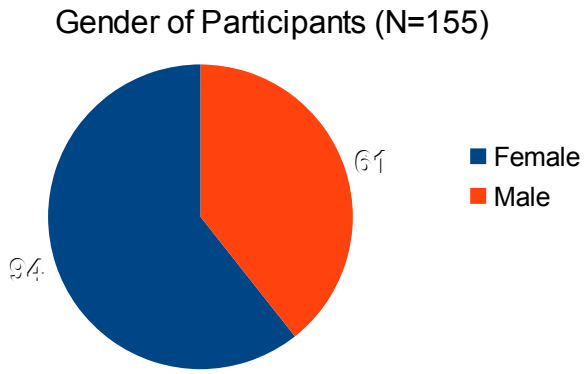

Figure 9: Gender of Participants

Participant ages ranged between 65 and 93, with each 5 year age bracket being smaller that the last. By comparing the population of this survey to the 2010 U.S. Census we see, in Figure 10, it can be seen that the population used in this research is similar in age composition to the general public. The oldest participant's response was collected in one of the senior center site visits, while the oldest on-line response came from an 87 year old male.

	65-69	**70-74**	**75-79**	**80-84**	**85-89**	**90-94**	**95+**	**Total**
On-line	21	12	6	2	1	0	0	**42**
Face-to-face	22	26	20	22	18	5	0	**113**

Table 4: Responses by Collection Method and by Age

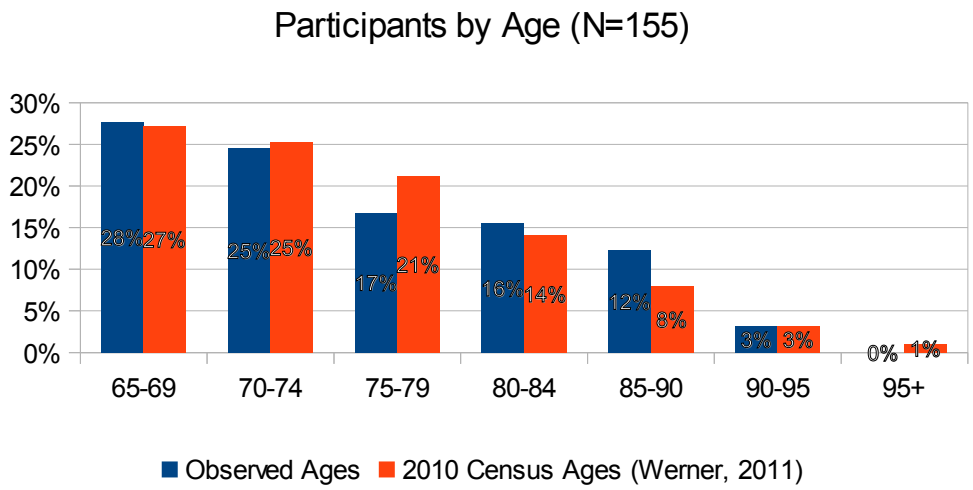

Figure 10: Participants by Age With Comparison to 2010 U.S. Census

Data Analysis

The questions on the survey fell into two general categories: 1) those with a list of choices that can be converted into a nominal scale; and 2) those that ask for a selection of one or more ordinal responses. The questions that asked a participant about their education, income, friends and family usage, media exposure, application knowledge/use, and others were presented with selectable options representing a range of numeric values. This grouping of values into a single possible response was done to simplify the questionnaire and have been converted back to nominal values in the analysis. Special care has been taken in the assignment of these nominal values to best represent the value of the

grouping. On questions with responses with an ordinal assignment, a direct conversion to a nominal value for analysis is not recommended or done. This nominal assignment of a value followed by a simple mean and standard deviation analysis may show some insight (Allen & Seaman, 2007) but may misrepresent the nature of the respondents' choice. These ordinal response questions are presented as counts and ratios of individuals in each of the categories, grouping of these counts, and the relationship between these counts. Many of the questions with ordinal responses included a place for participants to type in a free form response if one of the existing responses was not satisfactory. Few participants took advantage of this capability.

Findings

In this section, each of the five user groups will be analyzed and discussed based on their answers to the questionnaire sections that were presented to them. The first section was presented to all users and asked two questions about technology. The first question asked about computer usage and the second asked about smartphone use and knowledge. The second question was used to select the remaining sections of the questionnaire that were presented.

In the survey population a majority of seniors, 63% (n=97), have computers in their homes, and 39% (n=61) have one or more computers in their household and are comfortable using them. In a recent survey it was found that 53% of American adults 65 and older use the Internet or email (Zickuhr & Madden, 2012). It was also seen that 37% of them are on-line in a typical day (Zickuhr & Madden, 2012). The computer usage question in this research was much less detailed than the questions asked by Zickhur and Madden in their research but the findings are strikingly similar.

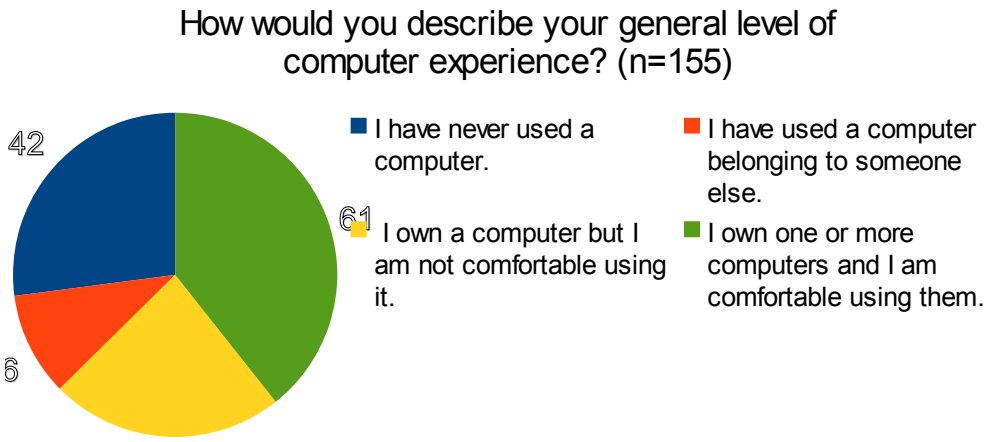

Figure 11: Computer Usage

The second question in the technology section asked seniors to choose a statement that best described their use and knowledge of smartphones and their

features. The five choices, the number of respondents, and the code associated with each of the choices are shown in the table below. This question was used to target specific questions about exposure, knowledge, use patterns, and motivations to the participants. The questionnaire results are broken down and discussed in four categories of responses: 1) those with little or some knowledge about the technology; 2) those who have considered the technology but have decided against adoption; 3) those who are currently using the technology; and 4) those individuals who had adopted the technology but are not currently using it.

Choice	n	%	Code
I currently have and use a smartphone.	24	15%	USE
I have had a smartphone in the past but am no longer using one.	3	2%	DIS
I have looked into getting a smartphone but have decided against it.	14	9%	REJ
I am curious about what a smartphone can do for me and have considered getting one.	15	10%	KNO
I know little or nothing about smartphones and their features.	99	64%	NOK
Total	**155**	**100%**	

Table 5: Smartphone Knowledge and Use

Individuals with Little or Some Knowledge (NOK and KNO)

The individuals in the two groups KNO (n_{KNO}=15) and NOK (n_{NOK}=99) were asked the same four questions about media exposure to the technology, knowledge of family members use of the technology, and if they had discussed the possibility of use of the technology with anyone. For the individuals who expressed curiosity and some knowledge (KNO) about the technology, they were additionally asked if they had experimented with the technology in a buying situation and what features they thought they would use if they were to adopt the technology. These participants are in the Knowledge and Persuasion phases of the IDT (Rogers, 2003). They are either in the Objectification phase of the STAM or for those with some knowledge are moving or have moved into the Experimentation & Exploration sub-phase of the Incorporation phase (Renaud & van Biljon, 2008). Of the respondents in these two groups ($N_{kno+nok}$=114), it was seen that 67% (n=76) of them currently have a mobile phone and that the remaining individuals do not.

Social influences have been shown to have a significant role in technology adoption. Three questions were asked about the influences upon individuals who have not adopted or rejected the technology. These questions asked: 1) about family and friend use of the technology, 2) about media exposure to the technology, and 3) about who the individuals have discussed the technology with.

When asked to estimate how many friends and family members have smartphones the most common response (33%, n=36) was that a majority of their friends and family have them. By converting their responses to a nominal scale, an estimated 56% of these respondents friends and families have a smartphone.

Another important social influence upon individuals is the media. Individuals were asked to estimate how often they saw advertising for smartphones in the following media types: newspapers, magazines, radio, television, internet, outdoor, and other advertising. It was seen that a majority of these individuals were exposed most days (70%, n=80) to advertising for smartphones and that almost all of them (96%, n=109) are exposed at least several times a month. Most of the exposure was seen on the television, followed by newspaper and internet advertising.

The last social influence question asked the individuals in this group if they had discussed the possibility of getting a smartphone with anybody. Only 30% (n=34) of the individuals in this group reported discussing this possibility. Discussion with children and grandchildren was most common and reported by 21% (n=24). Nine of the individuals in this group reported that they had spoken with two or more types of individuals including children and grandchildren, friends, spouses, business associates, and salespeople.

Fifteen (n_{kno}=15) individuals in this group said that they were curious about smartphones and have looked into getting one. They were asked if they had

looked at a smartphone in a buying situation and more than half (n=8) of them said they had. Then they were also asked about common applications for the smartphone and to estimate how often they would see themselves using these applications. Usage was estimated into one of six categories ranging from use one or more times a day to no regular use, and converted into nominal values. Using these nominal values it was found that curious users saw themselves using text and picture messaging 23 times a month, email 18 times a month, social media 15 times a month and the other categories less than 10 times a month. Overall they estimated, on average, that they would use apps on their smartphone, if they had one, 92 times a month.

Individuals Who Have Rejected the Technology (REJ)

The individuals in this group (n_{REJ}=14) have made a decision to not adopt a smartphone. They have entered into the non-conversion phase of the STAM (Renaud & van Biljon, 2008) and into the confirmation phase of the IDT (Rogers, 2003). Participants were asked to choose one or more statements that best described the reasons why they decided not to start using a smartphone. In addition to the eight responses offered, individuals were given the opportunity to enter a free form response. The responses, as seen in question 11 in Appendix A,

can be broken down into four general categories: 1) cost; 2) usefulness; 3) ease of use; and 4) social pressures.

An overwhelming majority (79%, n=11) of the respondents stated that cost was a factor in their rejecting the technology. Almost half (43%, n=6) found the smartphone too difficult to use. A significant minority (36%, n=5), stated that the device was not going to make them more connected with their friends and family. And, one participant stated that social pressure was a reason why they rejected the technology.

Current users (USE)

Current users (n_{USE}=24) were asked five questions about: 1) how they acquired their first smartphone, 2) how long they have had a smartphone, 3) their usage patterns, 4) motivations, and 5) if they would make the same decision again. The first four questions were asked to understand how or if the user had moved from the basic adoption of a technology in the Incorporation phase of the STAM into the full acceptance of the Conversion phase. The last question was asked to see if the examination of a previous decision and dissonance could be found as predicted by Rogers (2003) in the IDT.

A vast majority (83%, n=20) of current users purchased their first smartphone in a store. Three of them were given cast-off phones from family

members and only one of those said it was purchased new by a family member for them. None of the respondents to this section of the questionnaire were helped by friends to purchase or given a phone by a friend or employer.

Duration of usage varied from a few months to five or more years. The most common and median response was 1 or 2 years (42%, n=10). The remaining responses were evenly distributed less than a year (29%, n=7) and more than two years (29%, n=7).

Using the same nominal scale as used for the estimated usage in the KNO group, it was found that on average users in the USE group estimated that they used text and picture messaging 30 times a month, email 24 times a month, Web browsing 21 times a month, and social media 20 times a month. Most users (88%, n=21) used one or more apps on their phone one or more times a day. Overall they estimated their usage of apps on their phone to be 124 times a month. This is a 38% increase from the usage predicted by individuals who were curious about the technology but had not adopted the technology yet.

A list of reasons why the smartphone was adopted was presented to each participant and they were asked to choose one or more motivating factors in their original decision to adopt the technology. These reasons can be broken down into three general categories: 1) social pressures from family and friends, 2) technological advances and uses of the device that separate it from previous technologies, and 3) personal motivations. The social reasons were cited most

often (88%, n=24) as the motivation to initially adopt with the desire to have the new technological features the second most likely (71%, n=17). Half of the respondents (n=12) in this section of the questionnaire chose answers in all three categories suggesting that there were many factors, both internal and external, influencing the participant in this decision.

The IDT describes the uncertainty after making a decision to adopt or reject as dissonance. If the friction of dissonance becomes strong enough a user may change their original decision. The fifth question in this section asked the participants currently using a smartphone if they would make the same decision to adopt, knowing what they know today about the technology. A very large majority (92%, n=22) said they would make the same decision but a small observed group (8%, n=2) said they would not have adopted the smatphone with their current knowledge. The two users who would not make the same decision again each had very different usage patterns. One of them used email and other apps daily on their smartphone, but the other would only listen to music, text, and use social media a few times a month. The STAM states that acceptance "is an *attitude* towards a technology" (Renaud & van Biljon, 2008, p. 211), with this definition one of these users as shown by their daily use probably has reached acceptance of their smartphone while the other has not.

Individuals Who have Discontinued Use (DIS)

There were three respondents to the questionnaire who have used a smartphone in the past but have decided to discontinue the use (n_{DIS}=3). Because of the small result size aggregate statistics may not be generalizable. The letters A, B, and C will be used for the remainder of this section to represent the responses of these individuals.

Two of these individuals [A and B] reported that they did not use any of the smartphone specific features on their device. Respondent C did use email and a few applications on most days. The average application usage was a mere 37 application uses per user month compared to an average of 124 for current users and an estimated 92 by those who are curious about the technology.

Two of the individuals [A and B] had the smartphone less than a year while the third [C] had it for a year or two. Two of the individuals [A and C] were given the phone by a family member while one [B] purchased it at a store. The ratio of 2 to 3 is much higher than the 13% observed for this phenomena in the current users, but confidence in this difference must be tempered because of the small sample size for the discontinuers.

The original motivations to adopt were similar to the motivations seen in the group of current users. All three said that the social pressures were motivating factors and two of them were motivated by personal needs. Only one of the

respondents in this section stated that the need for smartphone specific features was a motivation, while 71% of the current users said this was a motivating factor.

The last question that was asked of these subjects was the same one that was asked to the participants who rejected the smartphone without trying it. These three users gave similar answers. Individual A responded with a typed in answer of "lost it – didn't care to replace", while not directly signifying why they discontinued use. Individual B chose a statement from the questionnaire that their discontinuance was because of the device's complexity and difficulty of use. Lastly, individual C chose both financial and general usefulness responses.

General Observations

The three figures following represent the percentages of surveyed seniors who have had or who currently have a smartphone (groups USE and DIS) versus age, education, and income. The bubble on the graph represents the number of respondents in that category and the trend line represents a best fit curve to fit the observed percentage of smartphone use for the graph x axis.

It was observed that no participants 80 or older were currently using or had used a smartphone. Of the remaining participants, aged 65-79, it was seen that 25% (n=24) of them have used a smartphone. By calculating Pearson's

Correlation Coefficient comparing the five year age bracket to the exponent of the percentage of individuals who have or have had a smartphone, to convert the logarithmic curve observed into a linear data set, there appears to be a very strong negative correlation (r=-.88) between these factors. Direct causality has not been shown nor has been investigated in this research.

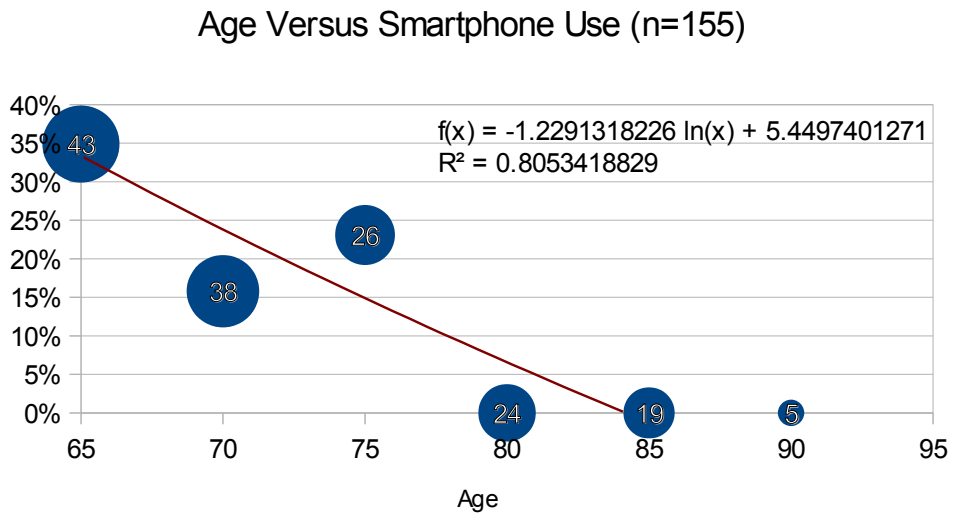

Figure 12: Age Versus Smartphone Use

Each participant was asked to estimate their annual household income from retirement, investments, and wages by choosing from nine different income brackets. A majority of individuals (n=113) answered this question. The lowest

wage in each bracket was used to calculate the relationship between income and smartphone usage. For individuals earning less than $15,000 a year it was seen that none of them were using or had a smartphone in the past. The three individuals in the $75,000 bracket and the one individual in the $200,000 bracket appeared to be outliers to the relationship between usage and income. Even accounting for these outliers, there appears to be a strong positive correlation (r=.56) between the lowest income in each of the income intervals and the exponent of the percentage of individuals in the bracket who have had or who currently use a smartphone. The direct causality can be speculated from the large number of individuals who chose cost (70%, n=12) as one of the reasons why they rejected or discontinued use of a smartphone.

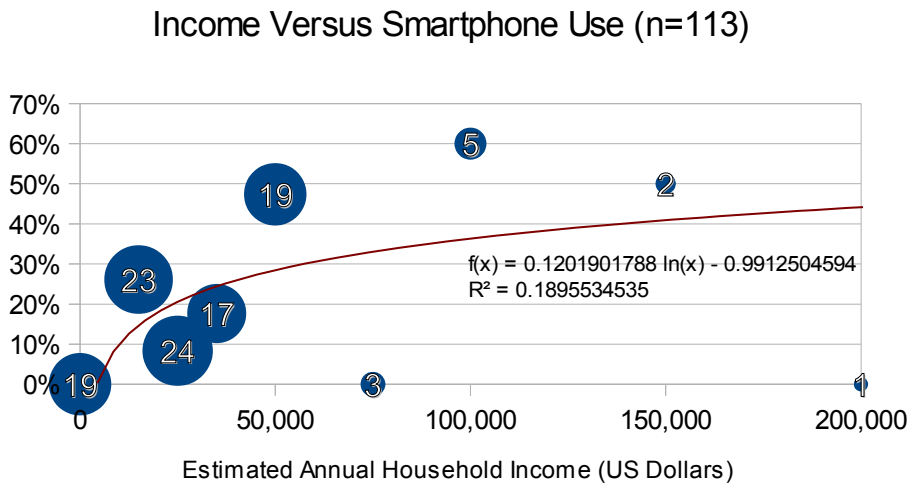

Figure 13: Income Versus Smartphone Use

In the demographics section of the questionnaire, participants were also asked to select their highest level of education, the full text of question 24 can be found in Appendix A. The choices have been converted to an estimated number of years for the chosen level of education. All but one participant responded to this question. By calculating Pearson's "r" on the relationship between the number of years of completed education and the exponent of the percentage of individuals who have used a smartphone there appears to be a very strong correlation (r=.80) between these two statistics. The causality has not been investigated but may include several different factors, including: technology use in chosen professions, literacy, or the very strong correlation between education and income levels (United States Census Bureau, 2012).

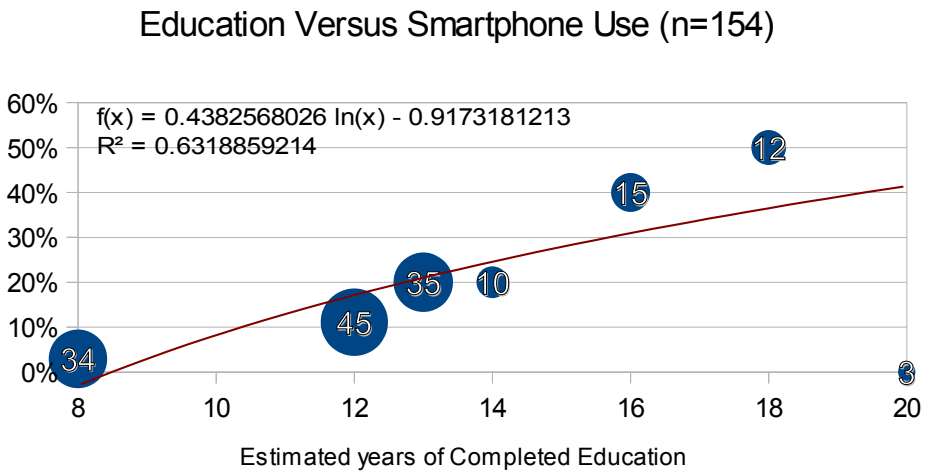

Figure 14: Education Versus Smartphone Use

Summary of Results

The data collected and reported in this chapter shows that the STAM, while valid for the original data used to create the model, does not completely model the findings of this research. These issues include the actual acquisition of the smartphone, discontinuance of use, and the under modeling of the usefulness of the device in individuals' decisions to reject, use, and discontinue use.

The strong correlations of age, income, and educational attainment to the use of a smartphone highlight the difference between individuals in the social grouping of American seniors. Seniors cannot be viewed as a single homogenous group, if a complete understanding is desired.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Conclusions

This research proposed two questions in Chapter 1. The first question asked if the Senior Technology Acceptance & Adoption Model (STAM) is a valid and representative model to study technology use by seniors, particularly their adoption of a different technology (smartphones) in a different population (US residents aged 65+). Based on the data collected and the observations made in this research this question can only be answered with a provisional yes. The STAM, while describing a general view, was skewed in its heavy reliance on ease of use and entire glossing over of the actual acquisition of the technology. Significant modifications to the STAM are suggested by this research to better describe what was observed and probably will be observed in other technological diffusion cycles with seniors. The second question asked if the phenomena of discontinuance, as described in the Innovation Diffusion Theory (IDT), happens in this research population and can it be modeled by expanding upon the STAM. This research clearly found examples, in the sample population, of individuals who have changed their minds about the adoption of a smartphone. Changes are

also suggested to the STAM to account for these individuals and the phenomena of reexamination.

When all of these recommendations are integrated into the STAM, as defined by Renaud and van Biljon (2008), the original model is significantly altered. This new model will potentially be more applicable to technology diffusion in general with the senior populations. Finally this chapter will recommend the need for additional research into the finer points of adoption and discontinuance, in the STAM, the modified STAM, and in other technology diffusion models for the general population.

Modifications to the STAM to Generalize the Model

Originally, the STAM was based on the Domestication of Technology (DOT) model rather than the IDT of Rogers (Renaud & van Biljon, 2008). It added a new *Non-Conversion* phase for individuals who reject a technology but removed the *Appropriation* phase of the DOT. *Appropriation* was left out of the STAM because in the population of seniors they interviewed it was seen that they "seldom make the decision to buy as their first phone is often given to them or bought for them" (Renaud & van Biljon, 2008, p. 217). This was not seen in the population of this study. A majority of users and one time users (78%, n=21), interviewed in this research, purchased the smartphone from a store, on their own.

To better model the observed, two changes are proposed to the original STAM *Objectification* phase: 1) renaming the first phase of the STAM to include the *Appropriation* phase of the DOT; and 2) adding the activity of actually purchasing or acquiring the technology to this first phase. The new *Acquisition* activity is added with a bi-directional connection to the *Intention to Use* and a uni-directional flow to *Experimentation & Exploration*. The flow to *Intention to Use* needs to be included for those seniors that were given a technology by a friend or family member before they actually have a personal desire to try a technology. The other flows to and from *Acquisition* model the individuals who follows through their intention to use and go and get the technology on their own.

The original STAM paper states "difficulty in learning to use a device is a determining factor for the elderly" (Renaud & van Biljon, 2008, p. 216). The strength of *Ease of Learning & Use* being a determinant factor was signified, in the STAM, by drawing arrows to and from it using a heavier weight than to the other factors, as seen in Figure 5. In the collected responses of individuals who have rejected or discontinued use of the technology an equal number of them (n=7) chose a lack of confirmed usefulness as difficulty to use as the reason for rejecting or discontinuing use. This suggests changing the flows for *Ease of Learning & Use* to the same weight in the model as the other two factors.

It can also be noted that current users of a smartphone estimated their usage of applications on their phone at 124 times a month, a rate of 35% more

often than users who were curious about a smartphone but who have not yet acquired one. This significance of *Confirmed Usefulness* of the device to finally drive *Acceptance* needs to be signified with a uni-directional flow from the former to the later.

In the STAM *Ease of learning and Use* is the only factor driving seniors to final rejection of the innovation. The predicted factor was seen in this research, but it was also seen that financial, social, and confirmed usefulness were significant factors in the final rejection of the technology. A majority of individuals who eventually rejected the technology in this study (71%, n=12) chose financial reasons for rejecting the innovation, while a significant portion of the individuals (41%, n=7) chose statements to the effect that a smartphone would not make them more connected to their friends and family. Two additional one-way flows originating at *Facilitating Conditions* and *Confirmed Usefulness* need to be added to *Rejection*, based on these findings.

These changes, with the addition to actually state the individual's flow from *Experimentation & Exploration* to *Actual Use*, generalize and clarify the STAM in the original scope it was defined. Figure 15 was created by overlaying these suggested changes over the original STAM diagram, with minor adjustments to the layout and using dashed lines and highlighting.

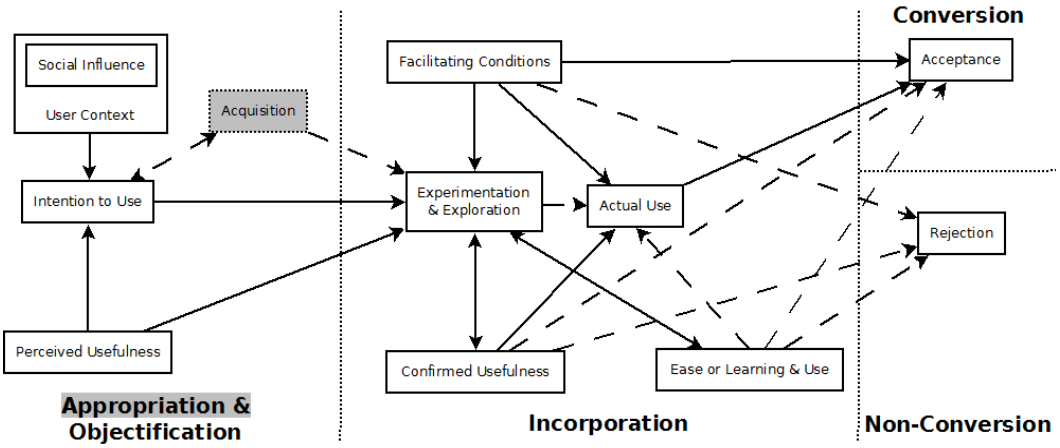

Figure 15: STAM with Generalization

Enhancing the STAM to Include Discontinuation

Even with the suggested changes above, the original scope of the STAM does not encompass the phenomena of reexamination of a decision to adopt or reject a technology at a later date. This research identified two groups of individuals, not identified in the original STAM, that need to be included to more fully realize the model in the senior population. These are 1) individuals who have adopted a technology but would not make the same decision to adopt, and 2) individuals who have had the technology in the past but have decided to cease using it.

Of the three users who have discontinued use of their smartphones, one of them was an almost daily user of the advanced features of their device, the other

two rarely used these features. One of the two current users who would not make the same decision to adopt uses email and other applications several times a day. Based on the usage patterns, two of these five (three who discontinued and two who would not adopt again) users may have moved into *Conversion* while the remaining ones are probably still in the *Actual Use* of the *Incorporation Phase*. Because of the dissatisfaction with their previous decision to get a smartphone and their actions to discontinue usage, two new relationships need to be included in the STAM to model these phenomena. The first is a connection from *Actual Use* to *Non-Conversion* and the second is a flow from *Conversion* to *Non-Conversion*.

The last change this research proposes to make to the STAM is the inclusion of a pathway from *Non-Conversion* back to the *Intention to Use* in the *Appropriation and Objectification* phase. This connection must exist to allow a previous decision to reject or discontinue using a technology to be reexamined in light of new information, conditions, and social pressures. This process was originally discussed in the ITD (Rogers, 2003) and was confirmed in this research. Figure 16 shows the original STAM with changes to model the phenomena of discontinuance and reexamination.

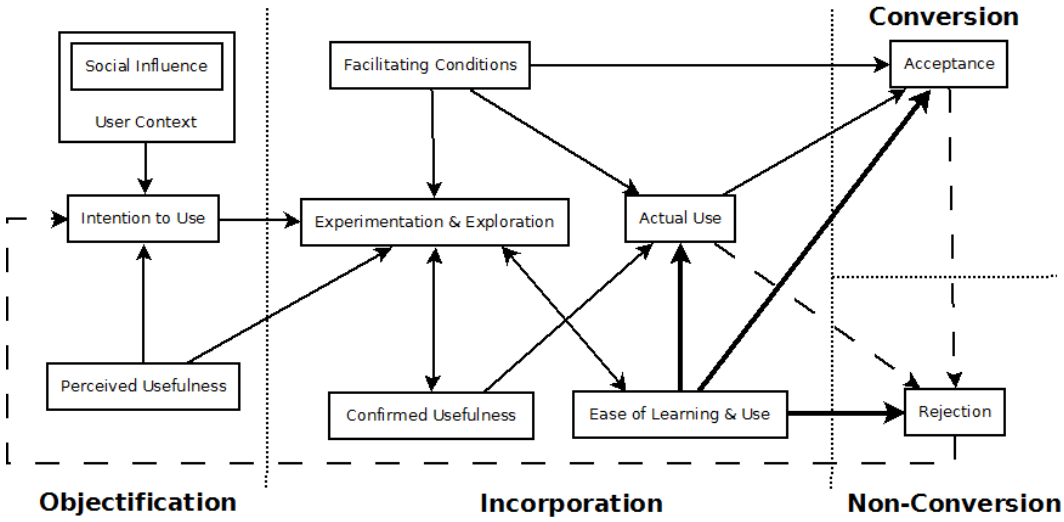

Figure 16: STAM with Reexamination of Original Decision

Integrating the Suggested Changes to the STAM

When this research was originally proposed, it was expected to find that the STAM was a complete model and that the only recommendations of this research would to be the addition of reexamination to the model. After collecting and analyzing the data this original view was incomplete. In light of the observations a significant number of changes need to be made to the STAM. Figure 17 shows all of the suggested changes made and the model rearranged for clarity. The severity of the changes, the strengthening of the use of the Domestication of Technology model, and the integration of the process of reexamination within the model suggests that a new model be created that integrates all of these changes. A suggested name for this new model is the

Senior Innovation Domestication and Life-cycle Model (SIDLM). The SIDLM is made up of the following constituents:

- *User Context* represents the society, culture, education, and circumstance surrounding an individual.
- *Perceived Usefulness* is created by education in the media and within a senior's social group. This represents the potential advantages of adopting the technology over non-adoption. At this point the individual may ask "What is this going to do for me that I can't already do?"
- *Intention to Use* is the actual decision to try the technology. The individual brings their *User Context* and perceptions about the technology into this activity. An individual with the intent to use may move to *Acquisition* or *Experimentation and Exploration*. A person may also be placed into this by the *Acquisition* of the technology by a third party.
- *Acquisition* is the process of actually getting a technology. An innovation may typically be acquired in three ways: 1) directly by the individual as a result of their *Intention to Use*; 2) by an outside actor who gives the individual the technology, thus creating the intention; and 3) a combination of the two where an outside actor, often a family member or an employer, assists the individual either with or without a prior intention.

- *Facilitation Conditions* include attitude of family and friends toward a technology, the temporal and financial cost of a technology, and general availability of the innovation.
- *Confirmed Usefulness* is the act of changing perceptions from the *Appropriation and Objectification* phase into the actual use and mastery of the technology. Believing that an innovation will do something for you or give you an advantage is not enough; the user must have tangible support for these beliefs to be willing to make the changes required. In the context of a smartphone, the user needs to see the advantages over having an older mobile-phone.
- *Ease of Learning and Use* was identified as the most important factor, driving confirmation, in the STAM. If the innovation is overly complex and creates a significant feeling of fear in the individual it will not be used. Without comfortable use the decision to try the technology will inevitability lead to *Rejection*.
- *Experimentation and Exploration* is where the user is trying the technology out for the first time. Their observations are being fed back into the *Confirmed Usefulness* and *Ease of Learning and Use* factors and will influence future interactions with the technology. Individuals may have acquired the technology on their own; be given the technology by a

third party; or be using a sample, loaner, rental, or demonstrator. The results of this activity will either be *Actual Use* or *Rejection*.

- *Actual Use* is where the individual is actually using the technology, but it is not fully integrated into the daily life nor is it fully being exploited. In the context of the smartphone, it is being carried with the individual, but the features that differentiate it from a regular mobile phone are not being used. During the use of the device the three factors (*Facilitating Conditions*, *Confirmed Usefulness*, and *Ease of Learning and Use*) will play a strong influence in the flow into *Conversion* or *Non-Conversion*.
- *Acceptance* is the *Conversion* phase and signifies that the individual has given the technology a level of importance in their lives. By this point in the model, a user has become comfortable with the technology and its limitations. A process of reinventing how it is being used continues to integrate the innovation into the daily fabric of the individual. The three factors (*Facilitating Conditions*, *Confirmed Usefulness*, and *Ease of Learning and Use*) may still influence a decision to reject or keep using the technology.
- *Rejection* is the act of *Non-Conversion* where the individual who has considered the technology, with an original intention to use it, subsequently has made the personal and direct decision to not domesticate the use of the technology. An individual may arrive at this point from

Actual Use, *Acceptance*, or from *Experimentation and Exploration* without actually acquiring the technology for themselves.

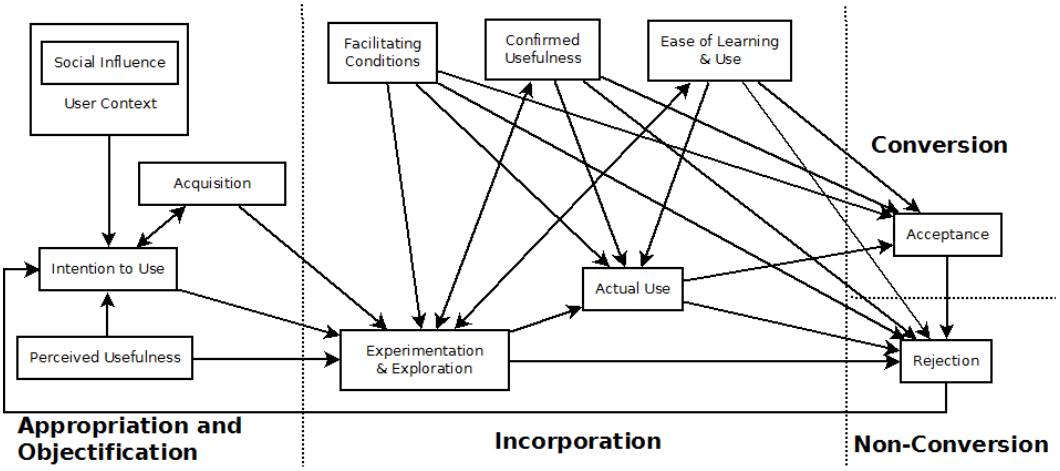

Figure 17: Senior Innovation Domestication and Life-cycle Model (SIDLM)

While at first this model seems overly complex, it does more completely fit the observations of this research. The SIDLM integrates the previous findings and recommendations of the STAM, IDT and the DOT into a single unified model that adds to the understanding of how innovations and technology diffuse into senior's lives. The SIDLM is an entire life-cycle model of an innovation as it is introduced, becomes widely accepted, reaches full adoption, and then becomes replaced with a new technology.

Implications

The SIDLM, recommended by this research, significantly integrates parts of three different models to create a unified model that describes the diffusion of two technologies in two different world cultures with older individuals. Despite the differences in societies and innovations, this new model suggests that the ways a senior may approach new technologies are more similar to an individual in the general population than different. This research makes contributions to general knowledge by giving future scholars, researchers, and business professionals a better understanding of how seniors adopt and react to new innovations.

Additionally this research brings to the forefront the phenomenon of reexamination of a previous decision to adopt or reject a technology. This understanding is missing from the STAM and several other commonly cited technology adoption models. This reexamination must also include the eventual obsolescence of a technology and allow for an adopter to gracefully leave *Conversion* at the end of a technology's usefulness.

Recommendations

An implication of any new model is the need for further research. This research must look at the model in more contexts than the limited research used to originally define it. As understanding increases, the model must be changed to reflect the changes to knowledge, culture, and technologies. Potential further investigation includes: 1) the need for larger and more statistically representative studies with the SIDLM; 2) research to gain a better understanding of discontinuance and reexamination in relation to other technology adoption models; 3) research to understand the process of reentry into *Appropriation & Objectification* from *Rejection*; and 4) the need to include age ranges outside the ones used in this research.

The SIDLM was based on a convenience sample of 155 American seniors. A vast majority of the responses (96%, n=149) were collected from residents of the states of Kentucky and Ohio. Of these individuals, a significant portion of them (76%, n=113) were surveyed in senior citizens centers and senior wellness programs in rural Appalachian counties. While this population may be skewed geographically, the findings should be generalizable to the general population of U.S. seniors even if the specific ratios and percentages observed may be somewhat different than in a more geographically diverse population. It is recommended that a larger and more statistically representative sample, of the

general U.S. senior population, be surveyed and used to validate or refute the findings of this research.

The TAM, UTAUT, and STAM models all reach their end when an individual has reached "actual use" (Davis et al., 1989), a "use behavior" (Venkatesh et al., 2003), and the "acceptance/rejection" (Renaud & van Biljon, 2008) of a technology. This research looked at the process of reexamination of a previous decision caused by an individual's discomfort with making an incorrect decision, based on the *Confirmation* phase of the IDT (Rogers, 2003). With continually changing technologies and the hypothesized exponential growth of technologies since the beginning of time (Kurzweil, 2006), these terminal models seem incomplete. A user's decision to adopt a technology is not static and permanent. A process of reexamination was observed in current users of the technology and also observed by including questions in the research to identify individuals who are no longer using a smartphone. While these observations were a small percentage of the population (3%, n=5) in this study, this phenomena needs much additional examination. How observable and how common is discontinuance and reexamination in other diffusions?

The proposed SIDLM includes a pathway/connection from the rejection of an innovation back to the *Intention to Use*. This phenomenon was not directly observed in the study but is a corollary of discontinuance. If users reexamine their decision to use a technology, then it follows that users will also reexamine

their decision to reject an innovation. The connection back to the intent in the earlier phase was made to show that the user has had a change of mind in relation to the technology. More research is needed to understand the influences on users to consider adoption after a previous rejection and exactly where they return in the *Appropriation and Objectification* phase of the SIDLM.

The definition of a senior citizen used in this research was an individual aged 65 or older. This definition is consistent with the definition used in the Medicare program, providing medical insurance to seniors in the United States ("Getting Medicare before you get your Full Social Security Retirement Benefits," 2008). The research used in the definition of the STAM used individuals aged 60 and older (Renaud & van Biljon, 2008). These inconsistencies in the definition of the minimum age of a senior need to be addressed in further study. The U.S. law authorizing senior citizens centers and other programs uses both the 60+ and 65+ definitions in the same law for various services and support to older Americans (*Older Americans Act of 1965, as Ammended*, 2006).

Summary

It has been been theorized that the development of innovations follow an exponential growth trajectory (Kurzweil, 2006) and that technological proliferation will continue to consume more and more of our lives and resources. The current and potential future changes are affecting all of humanity as they diffuse and are domesticated into the social fabric of life. The study of the diffusion of technology goes back into the 1950s with research into how agricultural advances moved through farming communities (Rogers, 2003).

One of the most commonly used models, the IDT, was introduced in 1962 and has been an important part of most technological and innovation diffusion research, since. The IDT (Figure 1) described a simple five-step model that followed an individual in a specific social context through their education about an innovation, decision to use or not use a technology, and their continual reexamination of that decision. Rogers created the IDT to describe agricultural processes but it has been adopted to model the diffusion of innovations in many fields. The TAM (Figure 3) was created as a framework describing technology adoption in a business setting and the organizational usage of a new computer hardware device or software application. The UTAUT (Figure 4) took eight different models, including the IDT and TAM, to create a single unified model. All of these models attempt to describe the adoption of a technology in a general

population. Another diffusion model was the DOT model. The DOT looks at the balance between the engineering process that creates a new technology and the domestication or integration of the technology into the lives of consumers. And lastly, the STAM (Figure 5) which uses a structure based upon the DOT to define a model of technology acceptance specifically to address the needs and differences of seniors.

Of the models listed above, only the IDT included a process for an individual to change their mind after the adoption of a technology. In the IDT a confirmation process is entered by all users, whether or not they have adopted the technology. As additional information is gained about the innovation through actual use, trial use, observing use in their social context, or through the media, the user may feel discomfort about their previous action/decision. If this dissonance becomes sufficiently strong, an individual may change their former decision and adopt or discontinue use of an innovation.

This research originally had two research questions: 1) to test the validity of the STAM within the social context of American seniors (age 65+) and with a different technology (smartphones); and 2) to see if dissatisfaction about a previous decision to adopt the smartphone occurred in the study population. A survey was created, based on the process of diffusion described in the STAM, for American seniors and focused on their use and knowledge of smartphones. The

survey also included questions to identify if seniors, in this context, had reexamined their decision or were sorry about the decision that they had made.

This survey collected responses from a convenience sample of 155 American seniors. Responses were solicited nationally on-line, in senior citizen centers in five Kentucky counties, and in a senior social and wellness program in Ohio.

For RQ1, to test if the STAM was a valid and complete model for the diffusion of smartphones in the population of American seniors, the collected data shows that the STAM is inadequate to describe the observations of this research. The STAM is incomplete in two significant areas: 1) by not describing how a technology was acquired and 2) in oversimplifying the motivations to accept or reject an innovation. In the original STAM, an overwhelming number of individuals were given the technology by a family member where this phenomena was only observed rarely in this research. The original DOT included a phase called *Appropriation* where the user actually brings the device or innovation home; it was left out of the STAM. The STAM also simplified the motivations in the *Incorporation* phase to weigh more heavily the importance of ease of use as the strongest motivation. This simplification was not seen in the survey answers of this research. Financial and other *Facilitating Conditions* were the most commonly cited motivations followed almost evenly by *Confirmed Usefulness*

and *Ease of Learning & Use*. This research proposes a restructuring of the STAM to overcome these issues.

For RQ2, to see if dissonance and reexamination of prior decisions can be observed, was shown in a small but significant number of individuals. This research suggests that a significant minority of studied seniors who currently have a smartphone would not make the decision to acquire it again based upon their current knowledge. Hindsight is 20/20, but these individuals are experiencing the dissonance as described in the IDT and may reexamine their decision to adopt, when they can. Another small group of individuals were found who had adopted the use of a smartphone but who later, for a variety of reasons, have discontinued use. This shows that the process of reexamining their previous decision does exist. This research recommends adding the process of reexamination of a previous decision, to the STAM, both with individuals who subsequently rejected a technology after adoption and also with the individuals who have adopted after a previous rejection.

When all of the changes to the STAM are made to represent the findings of this research, a new model, the SIDLM (Figure 17) was developed. This new model increases the understanding of how seniors domesticate and adopt technologies by integrating parts of the IDT, the DOT, and the STAM together to better represent the individuals surveyed.

Appendix A

Survey with Summary Responses

The survey began with a consent statement that the user had to accept to continue. Once the consent was accepted the participant was forwarded to Section One of the questionnaire to verify that they qualified for participation. Factors used to convert responses to a nominal scale and the codes used in the raw data Appendix C are included in the summary tables with each of the questions, where applicable.

Adult General Informed Consent

Consent for Participation in "An Examination of Acceptance, Adoption, and Diffusion of Smartphone Devices with Senior Citizens".

Funding Source: None.
IRB protocol #: Wang 03151301
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Nova Southeastern University
Office of Grants and Contracts
(954) 262-5369/Toll Free: 866-499-0790
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What is this study about?

This research study will look at how American senior citizens approach, use, and assimilate new technologies in their daily lives. As a participant you will be asked to take an on-line questionnaire with questions about your knowledge and use of smartphones along with a few general demographic questions. You do not need to currently have a smartphone to participate in this study. The questionnaire should take you less than 15 minutes to complete.

Why are you asking me and what will I be doing?

This research will be attempt to validate and extend a model that describes how new technologies are adopted by senior citizens. Specifically this research will ask 150 senior citizens who are residents of the United States of America and its territories to complete an on-line questionnaire to gain a better understanding of technology diffusion. This questionnaire will ask you general questions about yourself, your technology use, and your experiences with smartphones. You will not be asked any Protected Health Information during this process.

What are the dangers to me?

As you will be completing this on-line questionnaire in the environment and schedule of your choice, this research poses a minimal risk to participants. There are no direct benefits from your participation in this study.

Will I get paid for being in the study? Will it cost me anything?

There are no costs to you for participating in this study. After 150 qualifying participants have successfully completed the questionnaire, two individuals will be drawn at random and be sent a $50.00 “Amazon.com” certificate as a thank you gift. You must complete the questionnaire and provide a method of contact to be included in the thank you gift drawing.

How will you keep my information private?

Data collected during this study will only be used for the intended purposes listed in the description of the study (above). All information obtained in this study is strictly confidential unless disclosure is required by law. It is also possible that the Nova Southeastern University Institutional Review Board (IRB), other regulatory agencies, or the dissertation faculty advisor (above) may examine the records. During the course of this study, the data will be retained in encrypted files and password controlled computers with access granted only to the Principal Investigator.

What if I do not want to participate or I want to leave the study?

You have the right to leave this study at any time or refuse to participate. If you do decide to leave or you decide not to participate, you will not experience any penalty or loss of services you have a right to receive. If you choose to withdraw, any information collected about you before you leave the study will be kept in the research records for 36 months from the conclusion of the study but you may request that it not be used.

Voluntary Consent by Participant:

- By choosing "agree" below and continuing, you indicate that
- this study has been explained to you
- you have read this document or it has been read to you
- your questions about this research study have been answered
- you have been told that you may ask the researchers any study related questions in the future or contact them in the event of a research-related injury
- you have been told that you may ask Institutional Review Board (IRB) personnel questions about your study rights
- you are entitled to a copy of this form
- you voluntarily agree to participate in the study entitled "An Examination of Acceptance, Adoption, and Diffusion of Smartphone Devices with Senior Citizens"

At the conclusion of the survey you will be asked for optional contact information. Two participants in this study will be selected at random to receive a $50.00 Amazon.com Gift Card as our way of saying "thanks". This contact information will not be sold, rented, given, or used for any purpose other than to send out the "thank-you" gifts.

Please choose only one of the following:

○ Accept

○ Decline

Section One - Participant Qualifications

1. What is your age, today?

Age Range	Responses (n=155)	
65-69	43	28%
70-74	38	25%
75-79	26	17%
80-84	24	15%
85-89	19	12%
90-95	5	3%
95+	0	0%

2. Are you a resident of the United States or one of its territories?

Response	Responses (n=155)	
Yes	155	100%
No	0	0%

Section Two - Technology

3. How would you describe your general level of computer experience?

Statement (Choose One)	Code	Responses (n=155)	
I have never used a computer.	A	42	27%
I have used a computer belonging to someone else.	B	16	10%
I own a computer but I am not comfortable using it.	C	36	23%
I own one or more computers and I am comfortable using them.	D	61	39%

Question adapted from question used by Renaud and van Biljon (2008).

4. Please choose the statement that best describes your use and knowledge of smartphones and their features.

Statement (Choose One)	Code	Responses (n=155)	
I currently have and use a smartphone.	USE	24	15%
I have had a smartphone in the past but am no longer using one.	DIS	3	2%
I am curious about what a smartphone can do for me and have considered getting one.	KNO	15	10%
I have looked into getting a smartphone but have decided against it.	REJ	14	9%
I know little or nothing about smartphones and their features.	NOK	99	64%

Section Three - Objectification (Common)

5. Do you have a mobile-phone (one that is not a smartphone)?

Statement (Choose One)	Code	Responses (n=114)	
Yes	Y	76	67%
No	N	38	33%

6. Please estimate how many of your friends and family have smartphones?

Statement (Choose One)	Nominal Value	Code	Responses (n=114)	
None of them have a smartphone.	0.00	0	8	7%
A few of them have a smartphone.	0.25	1	29	25%
Around half of them have a smartphone.	0.50	2	22	19%
A majority of them have a smartphone.	0.75	3	36	32%
All of them have a smartphone.	1.00	4	19	17%

7. Choose the answer that best describes how often you see advertising for smartphones in each of these media:

Please choose one response for each media type:

n=114	1 - One or more times a day [45]	2 - Most days [22]	3 -A few days each week[12]	4 - A few times a month [3]	99 - I do not recall seeing this type of advertising [0]
N - Newspapers	7	15	21	17	54
M - Magazines	4	6	9	36	59
R - Radio	4	7	9	9	85

n=114	1 - One or more times a day [45]	2 - Most days [22]	3 -A few days each week[12]	4 - A few times a month [3]	99 - I do not recall seeing this type of advertising [0]
T - Television	45	29	20	10	10
I - Internet	7	7	5	7	88
B - Outdoor media (this includes: billboards, transit advertising, signs, and other)	2	6	9	19	78
O - Other	2	10	6	21	75

Listing of media types from Lamb, Hair, & McDaniel (2012, p. 283).

8. Have you discussed the possibility of getting a smartphone with any of these people?

Statement (Choose All That Apply)	Code	Responses (n=34)	
Friends	1	6	18%
Business associates	2	3	9%
Children / grand-children	3	24	71%
Spouse	5	10	29%
Salesperson (in a store selling plans or phones)	5	4	12%
Other	Other	0	0%

No response was given by 80 of the 114 that this question was presented to.

Section Four - Objectification (Some Knowledge)

9. .Have you personally looked at a smartphone in a buying situation?

Please choose all that apply:

Statement (Choose All That Apply)	Code	Responses (n=8)	
At a department/discount store	D	2	25%
At a cellular specialty store	C	7	88%
On-line	I	0	0%
Other	O	0	0%

No response was given by 7 of the 15 that this question was presented to.

10. If you were to get a smartphone please rank the following features as to how often you think you would use them:

n=15	1 - One or more times a day [45]	2 - Most days [22]	3 - A few days each week [12]	4 - A few times a month [3]	5 - I do not see myself using this feature on a regular basis [0]	99 - I do not know what this feature is, so I am unsure how to answer [0]
EM - Email	4	3	2	1	5	0
M - Music and Video	1	1	3	0	9	1
P - Productivity (Spreadsheets, PDF reading, and other Documents)	0	1	1	3	9	1

n=15	1 - One or more times a day [45]	2 - Most days [22]	3 - A few days each week [12]	4 - A few times a month [3]	5 - I do not see myself using this feature on a regular basis [0]	99 - I do not know what this feature is, so I am unsure how to answer [0]
D - Mapping, Driving Directions, and Global Positioning (GPS)	0	1	1	10	2	1
W - Internet Browsing	2	3	2	2	4	2
T - Text and Picture Messaging	5	4	3	0	3	0
S - Social Media (Services like: Facebook, Twitter, MySpace, and others)	3	3	2	1	4	2
V - Voice over the Internet (VoIP)	1	0	0	2	5	7
O - Other	1	1	0	3	4	6

List of smartphone features adopted from Dickson (2010).

Section Five - Reject Innovation

11. Please choose the statement(s) that best describe the reason(s) why you have decided not to start using a smartphone.

Statement (Choose All That Apply)	Code	Responses (n=14)	
The initial cost of the smartphone was too much.	F1	7	50%
The data plan to use the smartphone was too expensive.	F2	10	71%
I did not want to be under a new contract from the smartphone carrier.	F2	4	29%
There was only limited voice and data coverage in my area.	T1	0	0%
The size of the keys or screen made it too difficult to see or touch.	T2	3	21%
The complexity made it difficult to easily do what I wanted to do.	T3	4	29%
The smartphone was not going to make me more connected to my friends and family.	S1	3	21%
My friends did not have a smartphone and I did not want to be different.	S2	1	7%
Other: saw no personal benefit wasn't sure she could do it. She was told she needed lessons to use and didn't want to do that. added benefits did not justify added costs.	Other		

Section Six - Discontinue Usage after Previously Adopting

12. When you had a smartphone estimate how often you used the following features:

Please choose the appropriate response for each item:

n=3	1 - One or more times a day [45]	2 - Most days [22]	3 - A few days each week [12]	4 - A few times a month [3]	5 - I did not use this feature on a regular basis [0]	6 - I do not know what this feature is, so I am unsure how to answer [0]
EM - Email	0	0	0	0	3	0
M - Music and Video	0	1	0	0	2	0
P - Productivity (Spreadsheets, PDF reading, and other Documents)	0	1	0	0	2	0
D - Mapping, Driving Directions, and Global Positioning (GPS)	0	1	0	0	2	0
W - Internet Browsing	0	0	0	0	3	0
T - Text and Picture Messaging	0	1	0	0	2	0
S - Social Media (Services like: Facebook, Twitter, MySpace, and others)	0	0	0	0	3	0

n=3	1 - One or more times a day [45]	2 - Most days [22]	3 - A few days each week [12]	4 - A few times a month [3]	5 - I did not use this feature on a regular basis [0]	6 - I do not know what this feature is, so I am unsure how to answer [0]
V - Voice over the Internet (VoIP)	0	0	0	0	3	0
O - Other	0	1	0	0	2	0

List of smartphone features adopted from Dickson (2010).

13. Approximately how long did you use a smartphone before you decided to give it up?

Statement (Choose One)	Nominal Value	Code	Responses (n=3)	
A couple of months or less	0.167	0	1	33%
More than a couple months but less than a year	0.500	1	1	33%
1 or 2 years	1.500	2	1	33%
3 or 4 years	3.500	3	0	0%
5 or more years	5.500	5	0	0%

14. How did you acquire your first smartphone?

Please choose only one of the following:

Statement (Choose One)	Code	Responses (n=3)	
I purchased it from a store.	1	1	33%
I purchased it on-line.	2	0	0%
It was purchased new for me by a member of my family.	3	0	0%
I was given an old smartphone to use by a family member.	4	2	67%

Statement (Choose One)	Code	Responses (n=3)	
It was purchased new for me by a friend.	5	0	0%
I was given an old smartphone to use by a friend.	6	0	0%
My employer got it for me.	7	0	0%
Other:	O	0	0%

15. Please choose the statement(s) that best describe(s) why you initially decided to start using a smartphone.

Statement (Choose All That Apply)	Code	Responses (n=3)	
A friend or family member talked me into getting one.	S1	2	67%
I need to have a similar technology to my peers so that I am not outdated.	S2	0	0%
I have seen people with them and was curious.	S3	1	33%
I wanted to be more accessible to my family and friends.	S4	1	33%
I needed the mobile Web and Email connectivity.	T1	0	0%
I wanted to use social media (Facebook, Twitter, MySpace...) on the go.	T2	0	0%
I wanted to send text, picture, and video messages.	T3	1	33%
I wanted the GPS and mapping features to be with me everywhere I go.	T4	1	33%
I want to stay current with technology.	P1	1	33%
I wanted to have “apps” to play with and explore.	P2	0	0
The device is fun to use.	P3	1	33%
The device gives me freedom.	P4	1	33%
To increase my personal safety and security	P5	1	33%
Other:	O	0	0%

16. Please choose the statement(s) that best describe(s) why you have stopped using a smartphone.

Statement (Choose All That Apply)	Code	Responses (n=3)	
The initial cost of the smartphone was too much.	F1	1	33%
The data plan to use the smartphone was too expensive.	F2	1	33%
I did not want to be under a new contract from the smartphone carrier.	F3	1	33%
There was only limited voice and data coverage in my area.	T1	0	0%
The size of the keys or screen made it too difficult to see or touch.	T2	0	0%
The complexity made it difficult to easily do what I wanted to do.	T3	1	33%
The smartphone didn't make me more connected to my friends and family.	S1	1	33%
My friends did not have a smartphone and I did not want to be different.	S2	0	0%
Other: lost it - didn't care to replace didnt want to be bothered	O	2	67%

Section Seven - Use

17. Estimate how often you use the following features on your smartphone:

n=24	1 - One or more times a day [45]	2 - Most days [22]	3 - A few days each week [12]	4 - A few times a month [3]	5 - I do not use this feature on a regular basis [0]	99 - I do not know what this feature is, so I am unsure how to answer [0]
EM - Email	10	5	1	1	7	0
M - Music and Video	1	2	5	5	11	0
P - Productivity (Spreadsheets, PDF reading, and other Documents)	1	2	1	2	17	1
D - Mapping, Driving Directions, and Global Positioning (GPS)	0	1	2	9	12	0
W - Internet Browsing	9	4	1	1	9	0
T - Text and Picture Messaging	12	6	3	1	2	0
S - Social Media (Services like: Facebook, Twitter, MySpace, and others)	10	0	2	1	10	1
V - Voice over the Internet (VoIP)	0	1	1	2	13	7
O - Other	6	1	2	1	8	6

List of smartphone features adopted from Dickson (2010).

18. Approximately how long have you been using a smartphone?

Statement (Choose One)	Nominal Value	Code	Responses (n=24)	
A couple of months or less	0.167	0	0	0%
Less than a year	0.500	1	7	24%
1 or 2 years	1.500	2	10	42%
3 or 4 years	3.500	3	4	17%
5 or more years	5.500	5	3	13%

19. How did you acquire your first smartphone?

Statement (Choose One)	Code	Responses (n=24)	
I purchased it from a store	1	20	83%
I purchased it on-line.	2	0	0%
It was purchased new for me by a member of my family.	3	1	4%
I was given an old smartphone to use by a family member.	4	3	13%
It was purchased new for me by a friend.	5	0	0%
I was given an old smartphone to use by a friend.	6	0	0%
My employer got it for me.	7	0	0%
Other:	O	0	0%

20. Please choose the statement(s) that best describe(s) why you initially decided to start using a smartphone.

Statement (Choose All That Apply)	Code	Responses (n=24)	
A friend or family member talked me into getting one.	S1	3	13%
I need to have a similar technology to my peers so that I am not outdated.	S2	11	46%
I have seen people with them and was curious.	S3	9	38%

Statement (Choose All That Apply)	Code	Responses (n=24)	
I wanted to be more accessible to my family and friends.	S4	13	54%
I needed the mobile Web and Email connectivity.	T1	11	46%
I wanted to use social media (Facebook, Twitter, MySpace...) on the go.	T2	7	29%
I wanted to send text, picture, and video messages.	T3	15	63%
I wanted the GPS and mapping features to be with me everywhere I go.	T4	5	21%
I want to stay current with technology.	P1	9	38%
I wanted to have “apps” to play with and explore.	P2	10	42%
The device is fun to use.	P3	11	46%
The device gives me freedom.	P4	9	33%
To increase my personal safety and security	P5	7	29%
Other: stay in contact with facetime - video with the family daughter gave it to me don't like to talk on the phone, like to text schedule	O	4	17%

21. If you were going to redo the initial decision to get a smartphone, knowing what you know today, would you make the same decision?

Statement (Choose One)	Code	Responses (n=24)	
Yes	Y	22	92%
Maybe	M	0	0%
No	N	2	8%

Section Eight - Demographics

To complete this study we need to ask a few questions about you and where you live. If you are unwilling or unable to answer any of these questions, you may select "I do not wish to answer this question" from the list of responses.

22. What is your gender?

Statement (Choose One)	Code	Responses (n=155)	
Male	M	61	39%
Female	F	94	61%
I do not wish to answer this question.	NA	0	0%

23. What is an estimate of your annual household income (please include Social Security, pensions, and investment income)?

Statement (Choose One)	Code	Responses (n=155)	
Under $15,000 per year [0]	1	19	12%
$15,000 to $24,999 per year [15,000]	2	23	15%
$25,000 to $34,999 per year [25,000]	3	24	15%
$35,000 to $49,999 per year [35,000]	4	17	11%
$50,000 to $74,999 per year [50,000]	5	19	12%
$75,000 to $99,999 per year [75,000]	6	3	2%
$100,000 to $149,999 per year [100,000]	7	5	3%
$150,000 to $199,999 per year [150,000]	8	2	1%
$200,000 or more per year [200,000]	9	1	1%
I do not wish to answer this question.	NA	42	27%

Household income categories used in report by DeNavas-Walt, Proctor, & Smith (2011).

24. What is the highest level of education that you have completed?

Statement (Choose One)	Nominal Value	Code	Responses (n=155)	
Did not complete high school	8	1	34	22%
High school graduate or GED	12	2	45	29%
Trade or vocational school	13	3	8	5%
Some college but did not complete a degree	13	4	27	17%
Associates degree	14	5	10	6%
Bachelors degree	16	6	15	10%
Masters degree	18	7	12	8%
Doctorate or other terminal degree	20	8	3	2%
I do not wish to answer this question.		NA	1	1%

25. Which of the following best represents your current relationship status?

Statement (Choose One)	Code	Responses (n=155)	
Married	M	71	46%
Widowed / Widower	W	57	37%
Divorced	D	21	14%
Separated	S	1	1%
Never married	N	2	1%
Living with a partner	L	1	1%
I do not wish to answer this question.	NA	2	1%

Question from Harwell (2012).

26. In which state or territory do you currently reside?

Statement (Choose One)	Code	Responses (n=155)	
Kentucky	KY	106	68%
Ohio	OH	43	28%
West Virginia	WV	2	1%
Florida	FL	1	1%
Indiana	IN	1	1%
New York	NY	1	1%
Virginia	VA	1	1%
I do not wish to answer this question.	NA	0	0%

("Standard Postal Service State Abbreviations and ZIP Codes," 2012)

27. Which option best describes the area where your primary residence is located?

Statement (Choose One)	Code	Responses (n=155)	
Metropolitan area (population 200,000 or more)	1	1	1%
Large city (population 50,000 - 199,999)	2	1	1%
City (population 5,000 - 49,999)	3	66	43%
Town or village (population 2,500 – 4,999)	4	33	21%
Rural (population 2,499 or less)	5	53	34%
I do not wish to answer this question.	NA	1	1%

Community size breaks from the U.S. Department of Transportation ("U.S. Population Living in Urban vs. Rural Areas," 2011).

28. Which option best describes your current employment status?

Statement (Choose One)	Code	Responses (n=155)	
Working full-time for somebody else	F	10	6%
Working part-time for somebody else	P	8	5%
Self employed on a full or part-time basis	S	5	3%
Volunteering on a full or part-time basis	V	13	8%
Looking for work	L	3	2%
Retired	R	117	75%
I do not wish to answer this question.	NA	0	0%

("Employment Status - Survey Design Tips," n.d.)

Appendix B

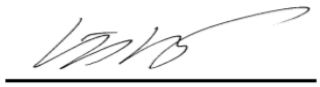
IRB Approval Memorandum

NOVA SOUTHEASTERN UNIVERSITY
Office of Grants and Contracts
Institutional Review Board

MEMORANDUM

To: James Reneau

From: Ling Wang, Ph.D.
Institutional Review Board



Date: April 4, 2013

Re: An examination of the acceptance, adoption, and diffusion of smartphone devices with senior citizens

IRB Approval Number: wang03151301

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms these must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE REACTIONS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and 954-262-2020 respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: Protocol File

3301 College Avenue • Fort Lauderdale, FL 33314-7796 • (954) 262-5369
Fax: (954) 262-3977 • Email: *inga@nsu.nova.edu* • Web site: www.nova.edu/cwis/ogc

Appendix C

Raw Survey Responses

The following tables represent the raw data collected during the questionnaire process. To simplify the data each questionnaire section is presented individually. All participants were assigned an alphanumeric identifier in the raw data to assist in connecting the data from the various sections of the questionnaire. This ID was created by concatenating their reported age, gender, and a sequence number. The question number, from Appendix A, is denoted on each table column.

Technology and Demographics (All Participants)

ID	How	Age - Q1	Gender - Q22	Income - Q23	Education - Q24	Marital Status - Q25	State - Q26	Urban Area - Q27	Work - Q28	Computer - Q3	Smartphone - Q4
65F1	F	65	F	5	6	D	OH	3	P	C	USE
65F2	F	65	F	NA	4	W	OH	3	R	B	REJ
65F3	F	65	F	NA	1	D	KY	3	R	A	NOK
65F4	F	65	F	5	6	M	KY	5	F	C	USE
65F5	F	65	F	4	2	M	KY	3	S	C	NOK
65F6	O	65	F	2	2	D	KY	5	R	D	USE
65F7	O	65	F	5	3	M	KY	5	R	C	NOK
65F8	O	65	F	3	2	M	KY	3	R	D	NOK
65M1	F	65	M	2	4	D	KY	4	V	C	USE
65M2	F	65	M	7	8	M	KY	3	S	D	REJ

ID	How	Age - Q1	Gender - Q22	Income - Q23	Education - Q24	Marital Status - Q25	State - Q26	Urban Area - Q27	Work - Q28	Computer - Q3	Smartphone - Q4
65M3	O	65	M	7	7	M	KY	3	F	D	USE
65M4	O	65	M	NA	2	W	KY	3	R	C	NOK
66F1	F	66	F	4	1	M	KY	5	R	D	NOK
66F2	F	66	F	3	4	M	KY	5	R	D	KNO
66F3	F	66	F	NA	6	D	KY	5	R	D	NOK
66F4	O	66	F	2	2	D	KY	4	R	D	NOK
66F5	O	66	F	2	2	S	OH	5	R	D	USE
66F6	O	66	F	2	2	M	KY	4	R	C	USE
66F7	O	66	F	5	2	M	OH	5	F	D	USE
66F8	O	66	F	5	7	D	OH	3	F	D	USE
66M1	O	66	M	5	6	N	OH	4	R	D	USE
66M2	O	66	M	5	7	M	KY	5	R	D	NOK
67F1	F	67	F	NA	1	D	KY	4	V	C	NOK
67F2	O	67	F	8	7	M	KY	5	R	D	KNO
67F3	O	67	F	5	2	M	KY	4	R	A	NOK
67M1	F	67	M	6	2	M	OH	4	R	D	NOK
67M2	F	67	M	1	1	D	KY	4	R	A	NOK
67M3	F	67	M	3	7	D	WV	4	U	D	REJ
67M4	O	67	M	5	6	M	KY	3	R	D	NOK
67M5	O	67	M	4	5	M	KY	3	R	D	DIS
68F1	F	68	F	3	2	M	KY	3	P	C	KNO
68F2	F	68	F	1	3	W	KY	3	P	D	NOK
68F3	O	68	F	4	7	W	KY	3	R	D	NOK
68F4	O	68	F	NA	5	W	OH	4	F	D	USE
68F5	O	68	F	NA	2	M	KY	5	P	D	NOK
68M1	F	68	M	7	7	M	OH	3	R	D	USE
68M2	F	68	M	2	2	M	KY	3	P	B	NOK
68M3	O	68	M	8	7	M	OH	3	R	D	USE
68M4	O	68	M	5	4	L	NY	5	R	D	USE
69F1	F	69	F	2	2	D	KY	3	V	D	NOK
69F2	F	69	F	1	1	M	KY	5	R	D	NOK
69F3	F	69	F	NA	1	W	KY	5	R	A	NOK
69F4	F	69	F	3	3	W	KY	5	R	B	NOK
70F1	F	70	F	1	5	D	OH	3	R	D	NOK
70F2	F	70	F	NA	2	W	KY	3	R	D	REJ
70F3	F	70	F	NA	2	M	KY	5	R	A	NOK
70F4	F	70	F	NA	2	W	KY	5	R	D	USE
70F5	O	70	F	3	6	M	OH	5	R	D	USE

ID	How	Age - Q1	Gender - Q22	Income - Q23	Education - Q24	Marital Status - Q25	State - Q26	Urban Area - Q27	Work - Q28	Computer - Q3	Smartphone - Q4
70M1	F	70	M	NA	4	M	KY	3	P	D	REJ
70M2	F	70	M	2	1	M	KY	4	V	A	NOK
71F1	F	71	F	2	6	N	OH	3	V	D	NOK
71F2	F	71	F	9	2	D	KY	3	V	B	NOK
71F3	F	71	F	1	2	D	KY	5	U	D	KNO
71F4	F	71	F	2	2	M	KY	4	R	A	NOK
71M1	O	71	M	5	7	M	IN	2	R	C	USE
71M2	O	71	M	5	4	M	KY	3	R	D	NOK
72F1	F	72	F	4	2	M	OH	3	V	D	NOK
72F2	F	72	F	3	4	D	OH	3	R	C	NOK
72F3	F	72	F	2	5	D	KY	4	R	D	NOK
72M1	F	72	M	4	5	M	OH	5	R	B	NOK
72M2	O	72	M	6	6	M	KY	3	R	D	KNO
73F1	F	73	F	3	4	M	OH	3	R	C	NOK
73F2	F	73	F	4	4	D	OH	3	R	D	DIS
73M1	O	73	M	7	7	M	OH	3	R	A	NOK
74F1	F	74	F	NA	2	M	OH	3	R	D	KNO
74F2	F	74	F	NA	2	M	KY	3	R	B	REJ
74F3	F	74	F	NA	4	M	KY	5	R	C	NOK
74F4	F	74	F	NA	1	NA	KY	5	V	B	NOK
74F5	F	74	F	1	3	W	KY	5	V	D	NOK
74F6	O	74	F	5	4	W	WV	4	F	D	USE
74F7	O	74	F	4	1	W	KY	4	R	A	NOK
74M1	F	74	M	3	5	M	OH	5	R	D	NOK
74M2	F	74	M	4	1	M	KY	5	F	C	REJ
74M3	F	74	M	NA	5	D	KY	5	R	C	NOK
74M4	F	74	M	3	4	M	KY	5	R	C	NOK
74M5	F	74	M	NA	1	M	KY	5	R	A	NOK
74M6	O	74	M	7	6	W	KY	4	S	D	USE
74M7	O	74	M	5	6	M	KY	5	R	D	REJ
74M8	O	74	M	2	1	M	KY	5	R	A	NOK
74M9	O	74	M	NA	8	M	OH	3	F	D	KNO
74M10	O	74	M	NA	6	M	KY	4	R	D	NOK
75F1	F	75	F	2	1	W	KY	3	R	C	DIS
75F2	F	75	F	2	1	W	KY	3	R	A	NOK
75F3	F	75	F	1	4	W	KY	5	R	A	NOK
75F4	O	75	F	5	6	W	KY	3	R	C	KNO
75F5	O	75	F	3	6	M	KY	3	R	D	KNO

ID	How	Age - Q1	Gender - Q22	Income - Q23	Education - Q24	Marital Status - Q25	State - Q26	Urban Area - Q27	Work - Q28	Computer - Q3	Smartphone - Q4
75F6	O	75	F	4	7	D	VA	4	R	D	USE
75M1	F	75	M	4	5	W	OH	3	R	D	NOK
75M2	F	75	M	2	4	W	KY	3	R	D	USE
75M3	O	75	M	1	1	W	KY	5	R	A	NOK
76F1	F	76	F	5	4	W	FL	1	S	C	USE
76F2	F	76	F	1	1	W	KY	5	R	C	NOK
76F3	F	76	F	NA	1	D	KY	4	R	A	KNO
76F4	F	76	F	3	3	W	KY	5	R	D	USE
76F5	F	76	F	NA	5	W	KY	5	R	D	NOK
76M1	F	76	M	3	4	M	OH	3	P	B	NOK
77F1	F	77	F	4	4	M	OH	4	R	C	NOK
77F2	F	77	F	NA	2	M	KY	3	V	A	NOK
77F3	F	77	F	1	1	W	KY	4	R	B	NOK
77F4	F	77	F	NA	1	W	KY	5	P	B	NOK
77F5	O	77	F	3	2	W	KY	3	R	D	REJ
77M1	O	77	M	NA	6	M	KY	3	R	D	USE
78F1	F	78	F	1	3	W	KY	4	R	D	NOK
78F2	F	78	F	NA	6	W	KY	5	R	C	NOK
78M1	F	78	M	4	2	M	KY	3	R	A	NOK
78M2	F	78	M	3	1	M	KY	3	R	A	REJ
79F1	F	79	F	NA	2	W	KY	3	R	A	NOK
80F1	F	80	F	NA	1	W	KY	3	R	C	NOK
80F2	F	80	F	2	4	W	KY	5	F	A	NOK
80F3	O	80	F	2	1	M	OH	5	R	A	NOK
80M1	F	80	M	3	4	M	OH	3	R	C	NOK
80M2	F	80	M	NA	1	M	KY	5	R	A	NOK
81F1	F	81	F	1	2	W	KY	4	R	B	NOK
81M1	F	81	M	3	1	M	OH	4	R	A	NOK
81M2	F	81	M	3	2	M	KY	3	R	C	NOK
82F1	F	82	F	NA	4	D	KY	3	R	C	NOK
82F2	O	82	F	5	2	M	KY	3	R	C	KNO
82M1	F	82	M	1	4	W	KY	4	R	A	NOK
82M2	F	82	M	3	2	W	KY	5	R	A	NOK
83F1	F	83	F	5	4	M	KY	3	R	B	NOK
83F2	F	83	F	NA	NA	NA	KY	NA	R	C	NOK
83M1	F	83	M	5	4	M	OH	5	R	B	NOK
83M2	F	83	M	4	3	W	OH	3	R	D	REJ
83M3	F	83	M	NA	4	M	OH	5	R	C	NOK

ID	How	Age - Q1	Gender - Q22	Income - Q23	Education - Q24	Marital Status - Q25	State - Q26	Urban Area - Q27	Work - Q28	Computer - Q3	Smartphone - Q4
83M4	F	83	M	NA	2	W	KY	4	R	A	NOK
84F1	F	84	F	3	2	W	OH	3	V	B	NOK
84F2	F	84	F	2	2	W	OH	5	R	A	NOK
84F3	F	84	F	3	4	W	OH	3	R	D	NOK
84F4	F	84	F	1	1	W	KY	5	R	D	NOK
84F5	F	84	F	NA	2	W	KY	4	R	C	KNO
84M1	F	84	M	4	2	M	OH	3	U	C	REJ
85F1	F	85	F	3	2	M	OH	3	R	A	KNO
85F2	F	85	F	2	2	M	OH	3	R	A	NOK
85F3	F	85	F	NA	1	W	KY	5	R	A	NOK
85F4	F	85	F	NA	1	W	KY	5	R	A	REJ
85F5	F	85	F	1	2	W	KY	5	R	A	NOK
85M1	F	85	M	2	3	M	OH	3	R	A	NOK
85M2	F	85	M	1	2	W	KY	5	R	A	NOK
86F1	F	86	F	NA	1	W	KY	4	R	C	NOK
86F2	F	86	F	NA	1	W	KY	5	R	A	NOK
86F3	F	86	F	1	2	W	KY	4	R	A	NOK
87F1	F	87	F	1	1	W	KY	5	R	A	NOK
87F2	F	87	F	4	7	W	KY	4	F	D	REJ
87M1	F	87	M	2	5	M	OH	3	R	D	NOK
87M2	F	87	M	NA	1	M	KY	3	R	A	NOK
87M3	O	87	M	6	2	M	KY	3	R	C	KNO
88M1	F	88	M	3	2	W	OH	5	R	C	NOK
88M2	F	88	M	4	2	M	OH	3	R	A	KNO
88M3	F	88	M	NA	2	W	KY	4	R	B	NOK
89F1	F	89	F	2	1	W	OH	5	R	B	NOK
90F1	F	90	F	1	1	W	KY	3	V	A	NOK
90M1	F	90	M	2	1	M	KY	4	R	C	NOK
92F1	F	92	F	NA	4	W	KY	4	R	A	NOK
92M1	F	92	M	NA	8	M	KY	3	S	A	NOK
93M1	F	93	M	3	4	W	OH	3	R	C	NOK

Objectification – Common (KNO & NOK)

ID	Mobile Phone - Q5	Friends and Family - Q6	Media - Q7							Discuss Technology With - Q8					
			N	M	R	T	I	B	O	1	2	3	4	5	Other
66F2	Y	2	99	4	99	1	3	99	99			Y			
67F2	Y	3	2	2	2	2	2	2	2	Y			Y		
68F1	Y	2	2	2	99	2	2	3	4	Y			Y	Y	
71F3	Y	2	99	4	99	1	99	4	4						
72M2	Y	3	3	4	4	2	4	99	99			Y	Y		
74F1	Y	2	99	99	99	3	99	3	3		Y	Y	Y	Y	
74M9	N	2	1	1	4	1	1	4	99		Y				
75F4	Y	3	2	2	99	1	99	2	99	Y					
75F5	Y	2	99	99	99	1	99	99	99	Y					
76F3	Y	2	2	3	99	1	99	2	2			Y		Y	
82F2	Y	3	3	4	3	2	4	4	99			Y			
84F5	Y	3	2	4	99	3	99	99	4			Y			
85F1	Y	4	99	99	2	2	99	99	4			Y			daughter in-law
87M3	Y	3	3	4	3	2	99	3	99			Y			
88M2	Y	4	1	99	99	2	99	99	99			Y			
65F3	Y	3	99	99	99	99	99	99	99						
65F5	Y	3	2	99	99	2	99	99	4						
65F7	Y	3	4	4	99	1	3	4	99			Y			
65F8	Y	1	3	4	1	1	2	3	4	Y		Y	Y		
65M4	N	0	4	99	99	99	99	99	99						
66F1	Y	3	3	99	99	1	1	99	4						
66F3	Y	3	4	4	99	99	1	99	4			Y			
66F4	Y	1	3	4	3	1	1	4	1						
66M2	Y	3	4	4	99	2	3	99	99			Y			
67F1	Y	1	3	99	99	1	99	99	99			Y			
67F3	N	1	99	4	99	4	99	99	99						
67M1	Y	3	99	99	99	1	99	99	99						
67M2	N	4	2	2	3	1	99	99	99					Y	
67M4	Y	1	3	4	99	4	99	99	99			Y			
68F2	Y	1	99	99	99	1	1	3	3						
68F3	Y	3	4	4	99	99	4	99	4						
68F5	Y	0	99	99	99	99	99	99	99						
68M2	N	3	4	99	99	1	99	4	4						
69F1	Y	4	2	3	99	2	3	3	3						

ID	Mobile Phone	Friends and	Media - Q7							Discuss Technology With - Q8					
			N	M	R	T	I	B	O	1	2	3	4	5	Other
69F2	Y	2	1	3	2	1	4	99	4						
69F3	N	1	3	99	99	3	99	99	99						
69F4	Y	1	99	99	99	3	99	99	99						
70F1	Y	3	99	99	99	3	4	99	4						
70F3	Y	4	1	3	99	1	99	4	4						
70M2	N	3	99	4	99	1	99	99	99		Y				
71F1	Y	0	4	3	99	3	99	99	99						
71F2	Y	2	3	99	99	2	99	99	4						
71F4	N	4	99	99	99	4	99	99	2						
71M2	N	1	4	99	4	4	99	99	99				Y		
72F1	Y	4	99	99	99	2	99	99	99						
72F2	Y	1	99	99	99	1	99	99	99						
72F3	Y	1	99	4	1	2	99	2	99						
72M1	Y	3	99	4	4	4	99	99	99						
73F1	Y	2	3	99	99	3	99	99	4						
73M1	Y	2	3	99	3	1	99	99	99						
74F3	N	0	99	4	99	3	4	99	99						
74F4	Y	3	99	99	99	2	99	99	99						
74F5	Y	4	99	4	99	4	99	99	99						
74F7	Y	4	2	1	2	2	2	1	2			Y			
74M1	Y	3	99	4	1	1	1	4	3						
74M10	Y	1	99	99	99	99	99	99	99						
74M3	N	3	3	3	99	1	4	99	3						
74M4	Y	0	3	3	99	1	1	99	2						
74M5	N	4	99	99	3	99	99	4	99						
74M8	Y	3	1	1	1	1	99	4	99	Y		Y	Y		
75F2	N	4	99	4	99	2	99	99	99						
75F3	Y	1	3	99	99	2	99	99	4						
75M1	Y	3	3	99	99	2	99	99	99						
75M3	Y	1	4	99	99	2	99	99	99			Y			
76F2	Y	3	99	99	99	1	99	99	99						
76F5	Y	3	99	4	99	1	99	99	99						
76M1	N	3	4	99	99	2	99	99	99						
77F1	Y	3	99	99	99	3	99	99	99						
77F2	Y	1	99	4	99	3	99	99	4						
77F3	Y	2	2	99	2	2	99	2	99						
77F4	N	4	3	99	99	1	99	99	4						
78F1	Y	3	99	99	99	3	99	99	99						
78F2	Y	1	3	99	99	4	99	99	99						

ID	Mobile Phone	Friends and	Media - Q7							Discuss Technology With - Q8					
			N	M	R	T	I	B	O	1	2	3	4	5	Other
78M1	Y	3	99	99	99	1	99	99	99			Y	Y		
79F1	N	1	99	99	99	2	99	99	99						
80F1	Y	4	99	99	99	4	2	99	99						
80F2	N	2	99	3	99	3	99	99	99						
80F3	Y	0	1	99	99	2	99	2	99			Y			
80M1	Y	1	99	4	4	3	99	4	4						
80M2	N	2	4	99	99	3	99	99	99						
81F1	N	2	99	4	4	1	99	99	99						
81M1	Y	3	99	3	99	1	99	4	2				Y		
81M2	Y	1	99	4	4	2	99	99	99						
82F1	Y	1	99	4	99	1	99	99	3						
82M1	N	1	99	99	3	99	99	99	99						
82M2	N	4	1	1	99	3	99	99	99						
83F1	N	1	2	4	99	1	99	1	2			Y			
83F2	N	2	99	99	4	3	99	99	99						
83M1	Y	1	99	4	99	1	99	99	99						
83M3	Y	3	2	99	99	3	99	99	99						
83M4	Y	3	99	99	99	1	99	4	99						
84F1	N	4	4	99	99	3	99	99	99						
84F2	Y	1	99	99	99	2	99	3	99						
84F3	Y	3	4	99	99	4	99	99	99						
84F4	N	2	99	99	99	1	99	99	99						
85F2	Y	3	4	4	3	1	99	4	2						
85F3	N	1	99	99	3	2	99	99	99						
85F5	Y	4	2	2	99	1	99	4	2			Y			
85M1	N	4	2	2	2	1	99	3	99				Y		
85M2	N	2	99	99	4	2	99	4	99						
86F1	Y	4	3	4	99	3	99	4	99						
86F2	N	1	3	99	99	1	99	99	99						
86F3	N	1	99	99	99	3	99	99	99						
87F1	N	4	99	99	99	1	99	99	99						
87M1	N	2	4	4	99	1	3	3	99			Y			
87M2	N	2	3	4	99	1	99	99	4						
88M1	Y	2	2	4	99	1	2	99	2						
88M3	Y	0	99	99	99	99	99	99	99						
89F1	N	2	99	99	99	99	99	99	99						
90F1	Y	1	99	99	99	2	99	4	99						
90M1	N	1	99	99	99	1	99	99	99						
92F1	N	3	4	4	99	4	99	99	4						

ID	Mobile Phone	Friends and	Media - Q7							Discuss Technology With - Q8					
			N	M	R	T	I	B	O	1	2	3	4	5	Other
92M1	N	0	99	99	2	1	99	99	99						
93M1	N	3	4	4	99	2	2	4	1			Y			

Objectification – Knowledge (KNO)

ID	Have Looked at Smartphone - Q9				Estimated Application Usage - Q10								
	D	C	I	Other	EM	M	P	D	W	T	S	V	O
66F2					1	1	4	5	2	3	1	5	4
67F2		Y			3	2	5	4	2	2	2	5	5
68F1	Y	Y			5	3	3	3	5	5	4	99	4
71F3					4	5	5	5	4	5	99	99	2
72M2	Y				1	5	5	4	2	3	2	4	5
74F1		Y			3	5	5	4	5	2	5	5	99
74M9		Y			5	5	5	4	5	5	5	5	5
75F4					1	3	4	4	4	1	1	99	99
75F5					1	5	5	4	1	1	1	1	99
76F3		Y			5	5	2	2	1	1	5	4	1
82F2		Y			2	5	5	4	3	3	3	99	99
84F5					2	3	4	99	3	1	2	5	5
85F1					5	5	5	4	99	2	99	99	4
87M3		Y			2	99	99	4	99	2	3	99	99
88M2					5	5	5	4	5	1	5	99	99

Reject Innovation (REJ)

ID	Reason to Reject - Q11								
	F1	F2	F3	T1	T2	T3	S1	S2	Other
65F2	Y					Y			
65M2					Y				
67M3		Y	Y						

ID	Reason to Reject - Q11								
	F1	F2	F3	T1	T2	T3	S1	S2	Other
70F2						Y	Y		She was told she needed lessons to use and didn't want to do that.
70M1	Y	Y	Y						saw no personal benefit
74F2	Y	Y				Y			wasn't sure she could do it.
74M2	Y	Y	Y		Y	Y	Y		
74M7	Y	Y							added benefits did not justify added costs.
77F5		Y					Y	Y	
78M2	Y	Y							
83M2		Y	Y						
84M1		Y							
85F4					Y				
87F2	Y	Y							

Discontinue After Previously Adopting (DIS)

ID	Application Usage - Q12									Duration - Q13	How Acquired - Q14
	EM	M	P	D	W	T	S	V	O		
67M5	5	2	2	2	5	2	5	5	2	2	4
73F2	5	5	5	5	5	5	5	5	5	0	1
75F1	5	5	5	5	5	5	5	5	5	1	4

ID	Motivation to Acquire - Q15													
	S1	S2	S3	S4	T1	T2	T3	T4	P1	P2	P3	P4	P5	Other
67M5			Y	Y			Y	Y	Y		Y			
73F2	Y													
75F1	Y											Y	Y	

ID	Reason to Discontinue - Q16								
	F1	F2	F3	T1	T2	T3	S1	S2	Other
67M5	Y	Y	Y				Y		
73F2						Y			didnt want to be bothered
75F1									lost it - didn't care to replace

Use (USE)

ID	Application Usage - Q17									Duration - Q18	How Acquired – Q19
	EM	M	P	D	W	T	S	V	O		
65F1	2	3	5	4	2	2	1	5	2	3	1
65F4	2	4	5	4	1	1	1	5	3	1	1
65F6	1	3	5	5	1	1	1	4	99	1	1
65M1	5	5	5	5	5	1	5	99	5	2	1
65M3	1	5	5	4	1	2	5	5	1	5	1
66F5	4	5	5	5	5	1	1	5	5	2	4
66F6	5	5	99	5	5	3	99	99	99	1	1
66F7	1	1	1	4	1	1	1	99	1	3	1
66F8	1	3	2	3	1	1	1	5	99	1	4
66M1	5	4	5	4	2	1	5	2	1	3	1
68F4	2	4	5	5	5	1	1	5	4	1	1
68M1	1	3	5	4	1	2	5	99	1	1	1
68M3	5	2	5	4	5	1	5	5	5	2	1
68M4	1	5	4	4	1	2	1	5	99	2	1
70F4	2	2	4	5	2	1	1	3	3	3	1
70F5	1	3	3	3	1	3	3	4	5	5	1
71M1	1	5	5	4	4	2	5	5	99	2	1
74F6	5	5	5	5	5	3	5	99	99	2	3
74M6	1	5	2	2	2	2	3	99	5	2	1
75F6	1	4	5	5	5	4	4	5	1	5	1
75M2	3	5	5	5	1	5	5	5	5	2	1
76F1	2	4	5	5	3	1	1	99	1	1	1
76F4	5	5	5	5	5	5	5	5	5	2	4
77M1	5	5	5	5	5	1	5	5	5	2	1

ID	Usage Motivation - Q20														Use Again - Q21
	S1	S2	S3	S4	T1	T2	T3	T4	P1	P2	P3	P4	P5	Other	
65F1			Y		Y	Y	Y			Y	Y		Y		Y
65F4		Y			Y	Y	Y	Y							Y
65F6			Y	Y			Y			Y	Y				Y
65M1		Y	Y	Y			Y		Y		Y	Y	Y	doesnt like to talk on the phone and likes to text	Y
65M3					Y									schedule	Y
66F5	Y		Y	Y		Y	Y			Y	Y		Y		Y
66F6			Y												Y
66F7		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y
66F8		Y		Y			Y		Y			Y			Y
66M1							Y								Y
68F4		Y													Y
68M1		Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y
68M3		Y		Y	Y		Y			Y	Y				Y
68M4				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
70F4		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y
70F5				Y	Y		Y	Y	Y	Y	Y				Y
71M1	Y														Y
74F6		Y													Y
74M6					Y										Y
75F6				Y											N
75M2		Y							Y			Y			Y
76F1	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	stay in contact with facetime - video with the family	Y
76F4														daughter gave it to me	N
77M1				Y			Y								Y

References

Allen, I. E., & Seaman, C. (2007). Statistics Roundtable: Likert Scales and Data Analyses. *Quality Progress*, *2007*(July). Retrieved from http://asq.org/quality-progress/2007/07/statistics/likert-scales-and-data-analyses.html

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *BMJ*, *314*(572). doi:10.1136/bmj.314.7080.572

Co, H. C. (1999). *The growth curve*. Technology and Operations Management, California Polytechnic and State University, San Luis Obispo, Calfornia. Retrieved from http://www.csupomona.edu/~hco/MoT/03bGrowthCurve.ppt

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003. doi:10.1287/mnsc.35.8.982

DeNavas-Walt, C., Proctor, B. D., & Smith, J. (2011, September). Income, Poverty, and Health Insurance Coverage in the United States: 2010. United States Census Bureau. Retrieved from http://www.census.gov/prod/2011pubs/p60-239.pdf

Dickson, F. (2010, June). Worldwide Smartphone Application Market: Revenues and Downloads. Retrieved June 27, 2012, from http://www.instat.com/abstract.asp?id=231&SKU=IN1004740MCM

Employment Status - Survey Design Tips. (n.d.). Retrieved July 9, 2012, from http://www.triberesearch.com.au/employment-status/

Getting Medicare before you get your Full Social Security Retirement Benefits. (2008, March 1). Centers for Medicare & Medicade Services. Retrieved from http://www.medicare.gov/Publications/Search/results.asp?PubID=11038&PubLanguage=1&Type=PubID

Groves, R. M., Fowler, F. J., Couper, M., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2009). *Survey methodology*. Hoboken, N.J.: Wiley. Retrieved from http://books.google.com/books?id=HXoSpXvo3s4C&printsec=frontcover&source=gbs_ViewAPI#v=onepage&q&f=false

Harwell, D. (2012, January). Testing of Demographic Questions in an ACASI Format. Questionnaire Research Design Laboratory, Office of Research and Methodology, NCHS. Retrieved from http://wwwn.cdc.gov/qbank/report/Harwell_NCHS_2012_ACASI.pdf#page=10

Itzin, F. (1970). Social relations. In *The daily needs and interests of older people* (pp. 137–164). Springfield, Il: Charles C. Thomas.

Kurniawan, S., Nugroho, Y., & Mahmud, M. (2006). A study of the use of mobile phones by older persons. In *CHI 2006 - Work-in-Progress* (pp. 989–994). Montréal. doi:10.1145/1125451.1125641

Kurzweil, R. (2006). *The singularity is near: when humans transcend biology*. New York: Penguin.

Lamb, C., Hair, J., & McDaniel, C. (2012). *Mktg 6.* South-Western Pub.

Lee, Y. S. (2007). *Older adults' user experiences with mobile phones: identification of user clusters and user requirements*. Virginia Polytechnic Institute and State University, Blacksburg, VA.

Limesurvey. (2013). Retrieved from http://www.limesurvey.org

Lohr, S. (2010). *Sampling: Design and analysis* (2nd ed.). Boston, MA: Brooks/Cole.

Maslow, A. (1970). *Motivation and Personality* (2nd ed.). New York: Harper & Row.

McMurtrey, M., McGaughey, R., Downey, J., & Zeltmann, S. (2010). Seniors and information technology: much ado about something? Presented at the 2010 Southwest Decision Sciences Institute conference, Dallas, TX. Retrieved from http://www.swdsi.org/swdsi2010/SW2010_Preceedings/papers/PA130.pdf

Narins, P. (1995). Guidelines for creating better questionnaires. SPSS Inc. Retrieved from http://www.htm.uoguelph.ca/MJResearch/ResearchProcess/QuestionnaireGuidelines.htm

Older Americans Act of 1965, as Ammended. , Pub. L. No. 109-365 (2006). Retrieved from http://www.aoa.gov/AOA_programs/OAA/oaa_full.asp

Open Source Initiative. (n.d.). Licenses by Name. Retrieved July 2, 2013, from http://opensource.org/licenses/alphabetical

Renaud, K., & van Biljon, J. (2008). Predicting technology acceptance and adoption by the elderly: a qualitative study. In *Proceedings of the 2008 annual research conference of the South African Institute of Computer Scientists and Information Technologists on IT research in developing countries: riding the wave of technology*. New York: ACM. doi:10.1145/1456659.1456684

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: The Free Press.

senior citizen. (n.d.). *Collins English Dictionary - Complete & Unabridged 10th Edition*. Retrieved from http://dictionary.reference.com/browse/senior citizen

Silverstone, R., & Haddon, L. (1996). Design and the Domestication of ICTs: Technical Change and Everyday Life. In *Communication by Design. The Politics of Information and Communication Technologies*. Oxford: Oxford University Press.

Smart Survey Design. (2011). Retrieved September 4, 2012, from http://help.surveymonkey.com/euf/assets/docs/pdf/SmartSurvey.pdf

Smith, A. (2011). *35 % of American adults own a smartphone*. Washington, DC: Pew Research Center. Retrieved from http://www.pewinternet.org/Reports/2011/Smartphones.aspx

Standard Postal Service State Abbreviations and ZIP Codes. (2012, May 23). United States Department of Treasury - Internal Revenue Service. Retrieved from http://www.irs.gov/pub/irs-utl/zip_code_and_state_abbreviations.pdf

Study highlights the role of seniors. (2007, May 28). *Richmond Times Dispatch*. Retrieved from http://www.timesdispatch.com/entertainment-life/study-highlights-the-role-of-seniors/article_998362a7-1fd7-5252-9994-3a5200938289.html

Sveiby, K., Gripenberg, P., Segercrantz, B., Eriksson, A., & Aminoff, A. (2009). Unintended and undesirable consequences of innovation. Presented at the XX ISPIM Conference: the Future of Innovation, Vienna.

technology. (n.d.). *The American Heritage Science Dictionary*. Retrieved from http://dictionary.reference.com/browse/technology

U.S. Population Living in Urban vs. Rural Areas. (2011, May). Retrieved July 9, 2012, from http://www.fhwa.dot.gov/planning/census_issues/archives/metropolitan_planning/cps2k.cfm

United States Census Bureau. (2012). *Mean Earnings by Highest Degree Earned: 2009* (No. SAUS 232). Retrieved from http://www.census.gov/compendia/statab/2012/tables/12s0232.pdf

Van der Heijden, H. (2004). User Acceptance of hedonic information systems. *MIS Quarterly*, *28*(4), 695–704.

Van Dijk, J. A. G. M. (2005). *The deepening divide: Inequality in the information society*. Thousand Oaks, CA: Sage Publishing.

Venkatesh, V., Morris, M., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. doi:10.2307/30036540

Werner, C. (2011). *The Older Population: 2010* (2010 Census Briefs No. c2010-br9) (p. 19). United States Census Bureau. Retrieved from http://www.census.gov/prod/cen2010/briefs/c2010br-09.pdf

Zickuhr, K., & Madden, M. (2012). *Older adults and internet use* (p. 23). Pew Research Center's Internet & American Life Project. Retrieved from http://www.pewinternet.org/Reports/2012/Older-adults-and-internet-use.aspx