

2017

Overcoming challenges in smart phone use among older adults in Saudi Arabia

Muath Alhussain Khawaji
Iowa State University

Follow this and additional works at: <https://lib.dr.iastate.edu/etd>

 Part of the [Computer Sciences Commons](#)

Recommended Citation

Khawaji, Muath Alhussain, "Overcoming challenges in smart phone use among older adults in Saudi Arabia" (2017). *Graduate Theses and Dissertations*. 16155.
<https://lib.dr.iastate.edu/etd/16155>

This Dissertation is brought to you for free and open access by the Iowa State University Capstones, Theses and Dissertations at Iowa State University Digital Repository. It has been accepted for inclusion in Graduate Theses and Dissertations by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

Overcoming challenges in smart phone use among older adults in Saudi Arabia

by

Muath Alhussain I Khawaji

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Human Computer Interaction

Program of Study Committee:
James H Oliver, Major Professor
Richard T Stone
Sunghyun Ryoo Kang
Jonathan Kelly
Doug W Jacobson

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of the dissertation. The graduate college will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa
2017

Copyright © Muath Alhussain I Khawaji, 2017. All rights reserved.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	iv
ABSTRACT	v
CHAPTER 1 INTRODUCTION	1
Technology and Older People.....	2
Guidance on Smart Phone Interface Design for Senior Citizens.....	3
Smart Phone Use in Saudi Arabia.....	4
Theoretical Framework.....	4
Purpose of Study and Research Questions	5
Chapter Summary	7
CHAPTER 2 REVIEW OF LITERATURE	8
Introduction	8
Technology and the Ageing Process.....	9
Challenges in the use of smart phones by seniors	11
Theories of Technology Adoption	18
The Influence of Culture and Language on Technology Adoption	21
Smart Phone Usage Patterns among Older Adults	26
Guidance on Smart Phone Design for Seniors.....	28
Use of Technology and Smart Phones in Saudi Arabia	34
Chapter Summary	36
CHAPTER 3 METHODS	37
Participants and Recruitment	38
Data Collection	40
Data Analysis and Interpretation	44
CHAPTER 4 SURVEY RESULTS	46
Characteristics of Participants.....	47
Attitudes to Technology.....	50
Smart Phone Usage	55
Ease of Use	61
Non Users of Smart Phones	67
Chapter Summary	74
CHAPTER 5 PROTOTYPE APPLICATION EVALUATION RESULTS	75
Design of the Prototype Application.....	77
Structure and Content of the Prototype Application.....	78

Recruitment and Participants	83
Evaluation Results	84
Chapter Summary	94
CHAPTER 6 QUALITATIVE INTERVIEW FINDINGS.....	96
Smart Phone Use among Saudi Arabian Seniors.....	97
Lack of Confidence or Experience in Using Technology	100
Practical Difficulties in Using Smart Phones	104
Language Related Influences on Use of Smart Phones	106
Cultural Influences on Use of Smart Phones	107
Encouraging other Seniors to Use Smart Phones	112
Chapter Summary	114
CHAPTER 7 SUMMARY, RECOMMENDATIONS AND CONCLUSIONS ..	116
Summary of Survey Findings	117
Summary of Prototype Evaluation Findings.....	117
Interview Findings and Discussion.....	118
Contribution of the Study	122
Practical recommendations	127
Recommendations for Future Research and Theory Development.....	128
Limitations of the Study	131
Conclusion	132
REFERENCES	134
APPENDIX A - SURVEY QUESTIONNAIRE	143
APPENDIX B - PROTOTYPE EVALUATION QUESTIONS.....	149
APPENDIX C - IN-DEPTH INTERVIEW QUESTION GUIDE	152
APPENDIX D - IRB APPROVALS	158

ACKNOWLEDGMENTS

I would like to thank my committee chair, James H Oliver, and my committee members, Richard T Stone, Sunghyun Ryoo Kang, Jonathan Kelly, and Doug W Jacobson, for their guidance and support throughout the course of this research.

In addition, I would also like to thank my parents, my wife, my friends and my siblings for their unfailing support during my studies, and my colleagues, the department faculty and staff for making my time at Iowa State University a wonderful experience. I want to also offer my appreciation to those who were willing to participate in my research, without whom, this thesis would not have been possible. Finally, I would like to express my gratitude to the Government of Saudi Arabia for sponsoring me to conduct my studies in the United States.

ABSTRACT

This empirical study investigates attitudes about smart phones and their use by senior citizens in the Kingdom of Saudi Arabia (KSA), and develops general design guidelines for a smart phone interface designed to appeal to this group and thus increase the adoption of smart phones among its members. The overall rationale for the study is to enable seniors in Arabic-speaking, predominantly Muslim countries to better access the proven benefits of smart phone use among seniors, including positive impacts on mental functioning, the adoption of healthier lifestyles through improved access to healthcare information and applications, and to support more autonomous and independent living. Many studies have generated best practice guidance on smart phone design for seniors, but these have mostly been conducted in Western, English-speaking countries. This research builds on existing best practice guidance but uses the study findings to prioritize the most important design points relating to the needs of Arabic-speaking users in Muslim countries, and to identify any required additions or modifications to the existing guidance and to current theories of technology adoption. The initial findings of a survey of Saudi Arabian senior citizens were used to develop a prototype smart phone interface, which was evaluated by a sample of participants. The outcomes of this trial and the findings of semi-structured interviews were then used to develop final recommendations for a smart phone application for use by the target population, and for a modified theory of technology adoption.

CHAPTER 1. INTRODUCTION

Studies conducted internationally have indicated that a high proportion of older people are not users of digital technology, and that many seniors face barriers such as a lack of confidence in using technology or physical conditions that make it difficult for them to use smart phones or other digital devices (e.g., Pew Center, 2014). A number of studies have generated best practice guidance on the design of smart phone interfaces for use by senior citizens. However, most smart phone interfaces are designed primarily for use by Western, English-speaking populations, and similarly, the best practice guidance on smart phone design for seniors has also mainly been developed based on research conducted in the West. Little previous research has been conducted into older people's use of smart phones in Arabic-speaking, predominantly Muslim countries, where seniors may face additional cultural and language-related difficulties in their use.

In Saudi Arabia, the setting for the proposed study, research with younger adults has confirmed the need to modify smart phone interfaces to the local culture and language. For example, Aldhaban, Daim and Harmon (2015) explored the impact of the Saudi Arabian cultural and social context on the use of smart phones in this environment. The intention of the authors was to develop a new theoretical model for use in Arabic settings based on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The study revealed in particular the role of language as a factor influencing take up of smart phones in Saudi Arabia, since smartest phone interfaces and content are designed primarily for English-speaking users. Al-Mouh & Al-Khalifa (2015) investigated the use of smart phones among a sample of Arabic-speaking visually impaired people in Saudi Arabia. They

found that 83% of participants were using an Arabic user interface and 91% were using touch screen phones due to the availability of Arabic support and the advanced features available on these phones. The vast majority were using iPhones because the screen reader of these phones supports Arabic.

This indicates that guidance on best practice smart phone design for seniors cannot be directly adopted for use by Arabic-speaking, Muslim seniors in Saudi Arabia and may need to be tailored to the specific needs of this population. Currently, an information gap exists in relation to the specific needs and requirements of Saudi seniors for a smart phone interface design. The proposed study is intended to fill this gap by conducting empirical research with this group and developing recommendations for a smart phone interface that will appeal to senior citizens in Saudi Arabia, as an example of an older Arabic-speaking, Muslim population. This is expected to increase the adoption of smart phones among this group, enabling them to better access the benefits of mobile technology that are well documented in the literature.

Technology and Older People

According to the United Nations *World Population Ageing Report* (2015), nearly every country worldwide is experiencing an increase in the number and proportion of older people in their population. In view of these demographic changes and growing numbers of seniors in most populations, there has been growing interest in the ways in which new technologies, such as smart phones, can be used by and provide potential benefits for this group. Researchers have found evidence of a positive relationship between the use of technology and general levels of well-being among older people (Mitzner et al., 2010), and

studies are revealing many ways in which smart phones and other computing devices are helping to prevent cognitive, sensory and motor decline among seniors, and enhancing their independence and daily functioning (Charness & Boot, 2009; Czaja et al., 2006; Ramon-Jeronimo, Peral-Peral, & Arenas-Gaitan, 2013).

Smart phones have been defined as “a hand-held computer capable of multiple functions in addition to placing calls” (Kaplan, 2012, p.129). Despite the considerable potential of smart phones and other Information and Communication Technology devices such as laptops and desktop computers for improving quality of life among seniors, there are various barriers to their use by this group. This is reflected in low levels of ownership and limited use of available smart phone functions. Anderson (2015) reports that in the United States only 30% of adults aged 65 or over own smart phones compared with more than 80% of adults aged between 18 and 49.

Researchers have documented a range of physical, cognitive and psychological difficulties often experienced by senior citizens when using smart phones. These include for example, physical and health challenges, decreases in cognitive abilities and in memory, declining visual and auditory abilities, and a lack of confidence in dealing with new technology, as discussed in the literature review presented in Chapter 2.

Guidance on Smart Phone Interface Design for Senior Citizens

A substantial body of literature in this area contains practical research-based guidance and recommendations on developing smart phone interfaces and other forms of technology for use by older people (e.g. Hawthorn, 2000; Strengers, 2012). This literature is based on a range of methods including systematic reviews and empirical research with older adults. Fisk

et al. (2009) highlight the importance of taking into account changes in perceptual, cognitive and motor systems when designing any form of technology for older people. Based on their focus groups with seniors, they found that 47% of the difficulties that older people face when using technology is related to financial, health related or other general concerns. Of the remainder, they concluded that 25% can be remedied by improved design of systems, and that the rest can potentially be resolved by training or a combination of training and design modifications. This suggests that improved design of smart phone interfaces to meet the needs of seniors is likely to help change attitudes towards smart phone use among this group and increase adoption. Based on a review of the literature in this area, the main recommendations for best practice smart phone interface design for seniors are summarized in Chapter 2.

Smart Phone Use in Saudi Arabia

No previous research has examined the use of smart phones or other new technologies among seniors in Saudi Arabia. However, a small number of studies have examined technology adoption and smart phone usage among younger people in Saudi Arabia and among Arabic-speaking users in the West, and have highlighted the need to adapt smart phone interface design to the needs of these groups, as discussed in Chapter 2.

Theoretical Framework

A number of theories have been developed to explain the adoption of technologies, which can be used to help inform the design of smart phones for use by older adults, and to structure research in this area. The most widely used is the Technology Acceptance Model

(TAM) (Davis, 1989), which was developed as a theoretical explanation of the factors influencing the adoption of technology, and built on earlier theories of technology adoption (Fishbein & Ajzen, 1975; 1980; Ajzen, 1991) which proposed that an individual's behavior in general is driven by his or her intention to perform an action, which in turn reflects the subjective norms of their society and their own attitude towards performing the behavior. The TAM applied the conceptual framework of these earlier models to the specific context of technology adoption, and identified two main attitudinal influences on technology adoption: perceived usefulness (PU), and perceived ease of use (PEOU). This is discussed in more detail in Chapter 2, along with other theories of technology adoption, and forms the theoretical framework for the study.

Purpose of Study and Research Questions

The purpose of the study is to investigate attitudes about smart phones and their use by senior citizens in Saudi Arabia, to identify the functionalities and features needed to promote the more rapid adoption of smart phones among the population of Arabic-speaking, Muslim seniors in Middle Eastern countries. The study builds on the existing published guidance on smart phone design for seniors, but prioritizes the most important design points corresponding to the needs of Arab-speaking users in the cultural setting of Saudi Arabia, and identifies ways in which the existing guidance needs to be modified to meet these needs. The initial findings of a survey of Saudi Arabian senior citizens regarding the use of smart phones are used to develop and trial a prototype religious smart phone application, with the outcomes of this trial as well as the survey findings being used to develop recommendations for a smart phone application designed for use by senior citizens in Saudi Arabia. A third

stage of research is intended to generate further insights into the influence of cultural and language on attitudes to and the use of smart phones among this group, through the use of qualitative interviews with a smaller sample of Saudi Arabian seniors, and to evaluate the applicability of existing theories of technology adoption to this population. In these ways, the study is expected to make a significant contribution to the existing literature relating to the design of smart phone design for seniors, particularly by taking into account the influence of factors such as culture, religion and language.

The study addresses the following research questions:

1. What are the characteristics of smart phone usage among senior citizens in Saudi Arabia?
2. What types of difficulties do senior citizens in Saudi Arabia experience when using smart phones?
3. How effective are existing theories of technology adoption for explaining attitudes to and use of smart phones among older adults in Saudi Arabia?
4. How do factors such as culture and language influence attitudes to and use of smart phones among this group?
5. What features should be included in a smart phone interface designed for use by senior citizens in Saudi Arabia, that will help increase the rate of smart phone adoption by this group?

Chapter Summary

This chapter has introduced the study and explained the rationale for conducting research on smart phone use among senior citizens in Saudi Arabia. The key points of relevant literature were summarized to confirm the need for research in this area, and a theoretical framework for the study was identified. Finally, the purpose of the study was defined and the specific research questions were set out. The following chapter presents the findings of a literature review relating to smart phone use among seniors, and identifies the information gaps that the study is intended to address.

CHAPTER 2. REVIEW OF LITERATURE

Introduction

This chapter presents a review of literature relevant to the understanding of smart phone use among senior citizens in Saudi Arabia. The purpose of the review is to position the current study within the existing field of knowledge in this area, to justify the need for the research due to knowledge gaps in this area, and ensure that the data collection instrument is designed to generate the types of information necessary to fill these gaps. The review has revealed seven main categories of literature in this area, which are discussed in the following sections.

First, the chapter examines the general research evidence relating to the adoption of smart phones by seniors and the potential benefits to this group of smart phone use, in order to justify the case for the current study. Next, studies are reviewed which have examined the challenges faced by seniors when using smart phones, and which are important in demonstrating the case for designing a smart phone interface specifically designed for use by seniors. The third section discusses technology adoption theories that have been used to understanding the adoption and use of smart phones and other new technologies among older adults. The fourth section discusses research that has examined the influence of factors such as language and culture on the adoption of technology. The fifth section examines the research evidence relating to the ways in which senior citizens use smart phones specifically, and new technologies in general. This is important in revealing the types of functions and features that might be incorporated in a smart phone interface designed for seniors, as well as other factors that need to be taken into account in order to encourage its uptake and use. The

sixth section presents the main findings of published research-based guidance on technology design for seniors. The final main section examines the available research evidence about the use of technology and smart phones in Saudi Arabia. Finally, the chapter summarizes the current state of research-based knowledge relevant to the use of smart phones among senior citizens in Saudi Arabia and identifies the main research gaps that the current study is intended to fill.

Technology and the Ageing Process

According to the United Nations *World Population Ageing Report* (2015), nearly every country worldwide is experiencing an increase in the number and proportion of older people in their population. Globally, one in eight people were aged 60 years or older in 2015, and by 2050 the total number of people in this age group is projected to double, reaching almost 2.1 billion (UN, 2015). In many developing countries, the rate of population ageing is much more rapid than occurred in developed countries in the past, requiring faster adaption of these countries to the needs of their senior citizens (UN, 2015).

In view of these demographic changes and growing numbers of seniors in most populations, there has been growing interest in the ways in which new technologies, such as smart phones, can be used by and provide potential benefits for this group. Researchers in the field of Human-Computer Interaction (HCI) are increasingly working on the development of new technological devices designed to improve independence and quality of life for older people (Barros et al., 2014; Dix, Finlay & Abowd, 2004), and the inter-disciplinary field of gerontechnology has emerged which integrates research on ageing with technological research and development. This field is concerned with understanding the ways in which

technology can be used to promote health, independence and social participation among seniors, and the development of technological solutions that address these issues, including information and communications technology (ICT) devices and applications (Bjering, Curry, & Maeder, 2014).

Researchers have found evidence of a positive relationship between the use of technology and general levels of well-being among older people (Mitzner et al., 2010), and have observed that the adoption of technology by this group is increasingly important in contributing to functional independence (Czaja et al., 2006). Some two decades ago studies were highlighting the potential of computer usage for helping to counteract the ageing process by providing important education, entertainment and socialization functions for seniors (Baltes & Baltes, 1990; Lawhon, Ennis, & Lawhon, 1996). With technological advances, studies are also revealing many ways in which computing devices are helping to prevent cognitive, sensory and motor decline among older people, and enhancing their independence and daily functioning (Charness & Boot, 2009; Ramon-Jeronimo, Peral-Peral, & Arenas-Gaitan, 2013; Slegers, van Boxtel, & Jolles, 2012). Other documented benefits of cell phones and other technological devices include facilitating long-distance care giving by family members, linking seniors to sources of medical advice and support and providing them with a greater sense of security and safety (Czaja & Lee, 2007; Kurniawan, 2008).

Despite the considerable potential of smart phones and other ICT devices for improving quality of life among seniors, there are various barriers to their use by this group, as reflected in low levels of ownership and limited use of available smart phone functions. Researchers (e.g. Czaja et al., 2006; Pew Internet and American Life Project, 2004) have documented a digital divide within populations, in which certain groups including older

adults have lower rates of access to and use of new technologies, and are therefore at risk of becoming increasingly marginalized and disadvantaged in society.

Smart phones have been defined as “a hand-held computer capable of multiple functions in addition to placing calls” (Kaplan, 2012, p.129). The adoption of these relatively low-cost devices by older people has been highlighted as one way of overcoming the digital divide and providing easy access to a wide range of information and support (Carmien & Manzanara, 2014). However, surveys have revealed high rates of cell phone usage among seniors, but a relatively low take-up of smart phones. For example, the Pew Research Center reports that 78% of adults aged 65 or over own a cell phone but only 30% own smart phones. In comparison, more than 80% of adults aged between 18 and 49 are reported to be smart phone users (Anderson, 2015). Dale & Schulz (2011) observe that although relatively few seniors indicate that they own a smart phone, it is possible that much higher numbers may possess this type of device but use it only for making calls, being unaware of or uninterested in the wider range of functions available, or encountering difficulties in their use. A substantial body of literature was located in the review that documents the various challenges and difficulties that many seniors face when using smart phones; this research is discussed in the following section.

Challenges in the Use of Smart Phones by Seniors

Physical and Cognitive Factors

It has been observed that smart phone interfaces are generally designed for younger users, with high-resolution displays, small screens and relatively few buttons used to perform multiple functions (Fisk, Rogers, Charness, Czaja, & Sharit, 2009; Lorenz & Oppermann,

2008). Researchers have documented a range of physical, cognitive and psychological difficulties often faced by senior citizens when using technological devices such as smart phones (Charness, Kelley, Bosman & Mottram, 2001; Fisk et al., 2009; Leung et al., 2010). These include for example, decreases in cognitive abilities and in memory, declining visual and auditory abilities, physical and health challenges and a lack of confidence in dealing with new technology.

Researchers have found, for example, that declines in cognitive abilities and working memory often make it more difficult for older people to learn and retain new skills and to carry out many technology-based tasks (Czaja et al., 2006; Fisk et al., 2009; Leung et al., 2010). Pak & McLaughlin (2010) point out that a decrease in spatial cognition, for example, affects the ability of seniors to construct the mental models necessary for developing and interacting with social networks via mobile devices. Declining visual abilities, experienced by all older adults to at least some extent, make it harder to perform tasks involving small font sizes, visually complex interfaces and low contrast colors (Bitterman & Shalev, 2004; Fisk, Rogers, Charness, Czaja, & Sharit, 2009; Kurniawan, 2008; Pak & McLaughlin, 2010). The use of smart phones by older people is also affected by declining physical abilities resulting from changes in muscles and bones, as well as cognitive and sensory changes that have an impact on movement (Fisk et al., 2009).

The challenges in technology use that are often experienced by older users have been demonstrated in a number of empirical studies conducted with seniors around the world. In research with 68 individuals aged over 60 who were attending day care centers in South Africa, for example, Leburu (2015) found that physical and mental health problems including reduced mobility, failing eyesight and memory problems were preventing the participants

from using mobile phones as much as they would like to. Charness & Holley (2004) observe that dexterity and other physical challenges often affect the ability of older people to perform tasks such as typing, while Häikiö, Isomursu, Matinmikko, Wallin, Ailisto, & Huomo, (2007) have noted that older users often have shaky handwriting that cannot be easily interpreted by the handwriting recognition software installed on some smart phones. As people grow older, and particularly as they reach very advanced ages, they are more likely to experience more serious health problems or disabilities that affect their physical abilities to use smart phones, such as arthritis (Lee, Chen & Hewitt, 2011).

Häikiö et al. (2007) conducted interviews with elderly smart mobile phone users and found that many experienced difficulties because the keypad buttons were too small. Based on their findings, Häikiö et al. (2007) recommended the use of touchscreens rather than physical buttons in mobile devices for seniors, which is in line with the conclusions of Murata & Iwase (2005) and Kobayashi et al. (2011). However, Cullen and Bratteteig (2013), Laguna (2008) and Sharma, However, Singh, Sharma and Aditya (2012) reported evidence that older people also experience difficulties in using touchscreens and prefer keypad buttons, indicating that there is little consensus about the best approach to smart phone interface design for older adults. Several researchers have argued, however, that smartphone applications designed for use by seniors should have large buttons, for example at least 16.5 x 16.5mm (Jin et al., 2007; Murata & Iwase, 2005).

Other Factors

Researchers have discovered that lack of confidence and anxiety about using new technology are important factors contributing to the low levels of usage of smart phones

among senior citizens, especially females (e.g. Pan & Jordan-Marsh, 2010). As Leung et al. (2010) point out, compared with younger people who have grown up using computers, many seniors have low levels of previous experience of technology on which to draw when using smart phones, and this has a negative impact on their confidence. Similarly, Fisk et al. (2009) observe that older adults face greater difficulties in using new technologies because they have lower rates of relevant transferable skills than younger people, and different mental models of how technology functions because of this differential experience. A number of studies have found evidence of high levels of anxiety and a lack of confidence among older adults about using new technologies and the Internet and this often results in a reluctance or avoidance of doing so (Lee et al., 2011; Pan & Jordan-Marsh, 2010; Rosenthal, 2008).

Researchers have also found that seniors avoid using information technology because of their perceived lack of relevant knowledge and skills and the non-availability of suitable training (Mann, Belchior, Tomita, & Kemp, 2005). Studies have found a widespread perception among older users that mobile phones are difficult to use. For example, Lee (2007) conducted survey research with 154 older users of mobile phones to explore their experiences and attitudes towards these devices. The study revealed that, overall, participants were only using a few functions of their phones, and were experiencing difficulties in areas such as menu navigation, text input and understanding error messages. One of the main findings of Leburu's (2015) qualitative research with older mobile phone users in South Africa was the lack of ability to use many features of mobile phones, which were perceived to be too complex. For some, this even included basic features such as making calls. Tang and Kao (2015) conducted research with elderly mobile phone users in Japan and found that

even after a year or more of usage, misunderstanding of basic functions was widespread among the sample of participants.

Many researchers have used the concept of self-efficacy to explain the attitudes of seniors towards the use of technology. Self-efficacy refers to the belief in one's own ability to succeed in a particular task or situation (Bandura, 1986). For example, Czaja et al., 2006) analyzed data from the Center for Research and Education on Aging and Technology Enhancement (CREATE) on the use of technology and the Internet by a large sample of adults in the U.S. aged from 18 to 91 and found evidence of lower levels of self-efficacy and higher levels of anxiety in this area among older and middle aged adults compared with younger adults. Other studies have similarly found evidence of low-self efficacy among seniors regarding the new of new technologies (e.g. Heinz, 2013; Laguna, 2008).

Quantitative studies in this area have also highlighted gender differences in attitudes to technology among older adults with female participants generally exhibiting lower levels of self-efficacy and confidence than male participants (e.g. Lee, 2007). Rosenthal (2008) found that 48% of the older female participants in her study expressed feelings of stress and anxiety when they began to use a computer.

A number of studies have revealed the ways in which low levels of smart phone usage among older adults result from multiple and often interacting factors. For example, the findings of Leburu's (2015) qualitative research with seniors in South Africa revealed that many of the research participants faced difficulties in using their phones, resulting from the cognitive and physical effects of ageing. There were also low levels of interest and negative attitudes towards mobile phones among this group because of their perceived complexity, and a tendency to use them for very limited purposes such as making calls to family and

friends. The study also revealed an increased sense of dependency among these older mobile phone users, who often needed to turn to their children or grandchildren for assistance in using their phones (Leburu, 2015). Based on discourse analysis of qualitative data from a sample of seniors, Turner, Turner & Walle (2007) also identified a range of factors affecting seniors' willingness to use new information and communications technologies, including anxiety, a reported lack of time for learning new skills and the absence of a clear purpose for adopting the technology. In the case of physical factors, Gregor & Newell (2001) observe that older people often experience multiple minor health or disability issues, which interact to produce a significant barrier to the use of information technology.

Practical factors also present barriers to the effective use of new technologies, including smart phones, among older adults. These include, for example, financial barriers due to the cost of computers and smart phones (Lee et al., 2011); concerns about privacy and data security (Caine, Fisk, & Rogers, 2006), and a lack of assistance or training in the use of the technology (Morrell, Mayhorn & Bennett, 2000). Researchers have also found that many seniors prefer in-person communications and that this discourages them from adopting smart phones (Clark, 2002; Lindley, Harper & Sellen, 2009).

Categories of Older Users

It is important to recognize, however, that there is great diversity within the population of older adults which results in considerable variety in attitudes to and usages of smart phones and other new technologies (Fisk et al., 2009). The Pew Internet and American Life Project (2003) uncovered high rates of technology adoption similar to those of younger adults among certain subgroups of the older population, referred to in the report as "Silver

Surfers”. In broad terms, Fisk et al. (2009) distinguish between two main groups of older adults, the “younger old”, aged from around 60 to 75, and the “older old” consisting of those aged over 75.

In a different approach, Gregor & Newell (2001) identified three sub-categories of older people, all of which have characteristics and needs that distinguish them not just from one another but also from younger adults. These consist of a group of older people who are fit and healthy, but have different needs, preferences and functionality to younger adults; frail older people who often have some form of disability as well as experiencing the general decline in functionality associated with ageing, and finally people with a long-term disability who are also ageing and experiencing a decline in other faculties that they have always been very dependent on. These findings provide support for Tang and Kao’s (2005) argument that “elderly” users of mobile phones should be defined not just in terms of age but based on their familiarity with the underlying concepts of mobile phone usage.

Other researchers have categorized older people by their attitudes towards smart phones and other new technologies. For example, Vicente and Lopes (2016) interviewed 1,501 users of mobile phones in the Portuguese population, 363 of whom were aged 55 or older. They identified three main categories: “Apathetic” users who make little use of their phones apart from calling family and friends; “social and hedonic” users who see their phone as a social status symbol, and a “busy and active” category who use their phone mainly for work purposes. Vicente and Lopes (2016) found that 47.8% of respondents aged 75 or older belong to the “Apathetic” category of users and concluded that this is largely due to the difficulties they experience in dealing with technological devices, as well as their limited need for social networking and communications.

Theories of Technology Adoption

A number of theories have been developed to explain the adoption of technologies, which can be used to help inform the design of smart phones for use by older adults, and to structure research in this area. The most widely used is the Technology Acceptance Model (TAM) (Davis, 1989), which was developed as a theoretical explanation of the factors influencing the adoption of technology. This built on the earlier Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975; 1980; Ajzen, 1991), which proposed that an individual's behavior in general is driven by his or her intention to perform an action, which in turn reflects the subjective norms of their society and their own attitude towards performing the behavior. Somewhat later the Theory of Planned Behavior (TPB) (Ajzen, 1991) added the additional construct of perceived behavioral control to the TRA model. The TAM applied the conceptual framework of these earlier models to the specific context of technology adoption, and identified two main attitudinal influences on technology adoption: perceived usefulness (PU), and perceived ease of use (PEOU). Under the TAM model, PU mediates the impact of PEOU on attitude to technology (AT), and PU and AT predict behavioral intention to use the technology, which has a direct impact on actual usage. The model assumes that individual-level differences and task characteristics are completely mediated by PU and PEOU.

Some writers (e.g. Arning & Ziefle, 2009; Bagozzi, 2007) have criticized the TAM model for its relative neglect of other factors that are argued to have a direct influence on technology adoption such as gender, age and personality. To address this, Venkatesh, Morris, Davis & Davis (2003) developed the United Theory of Acceptance and Use of Technology model (UTAUT), which acknowledged that the impact of PU and PEOU on technology adoption could be moderated by gender, age and other individual-level factors. Other

researchers (e.g. Al-Gahtani, 2008) have successfully used the TAM framework to examine the impacts of individual level factors such as age and gender on the relationships between the main variables of the model.

Rogers' (2003) Theory of Diffusion of Innovations can also be valuable in helping to explain acceptance of smart phone technology among older adults. According to this theory, there are five main categories of individuals defined in terms of their attitudes towards adopting new technologies. These consist of "innovators, early adopters, early majority, later majority and laggards" (Rogers, 2003, p.22). Innovators and early adopters are especially important in influencing the take-up of an innovative technology throughout their social group, through the ways in which they demonstrate its benefits and communicate these to their peers.

TAM remains the theoretical model that is used most widely in research on the acceptance of technology among older people, and has been proven effective as a model for explaining technology usage behavior among this group (Chen & Chan, 2011). Pan and Jordan-Marsh (2010) found, for example, that the model could be used to predict Internet usage behaviors among a sample of older Chinese people, and found that the impact of perceived ease of use (PEOU) was stronger for older than for younger seniors within this sample. Al-Gahtani (2008) confirmed the applicability of the TAM model in the Arab context based on a questionnaire survey of 722 knowledge workers using desktop computers in Saudi Arabia. The study found that age is the most significant factor moderating the influence of perceived usefulness and perceived ease of use on attitudes to technology and intention to use in this setting.

Using a theoretical framework broadly based on the TAM model, Heinz (2013) carried out a quantitative survey to identify factors predicting technology adoption among older adults. Higher perceived usefulness was found to be associated with more positive attitudes to technology, which in turn were associated with higher levels of technology adoption. Age had a negative impact, with older adults less likely to adopt technology than younger participants. In focus groups research, Fisk et al. (2009) similarly confirmed the importance of the perceived usefulness of technology in influencing take-up by older adults, and stressed the need for designers to communicate the benefits of technologies to this group. Jakobs et al. (2008) also stressed that older people will be more likely to adopt information and communications technologies (ICT) when the benefits are clear to them, and when clear instructional guidance is provided.

Other studies have revealed important insights into the types of factors influencing attitudes towards and usage of smart phones among older users in Western countries which can be built into future research to examine the relationships between key variables of the theoretical models and to develop more advanced models applicable in different cultural settings. For example, in quantitative research with older adults in the U.S., Lee (2007) found that satisfaction with mobile phones was influenced by three main factors: perceived usefulness, perceived ease of use and pleasure of use. Several studies have identified the key role of personality traits and other personal characteristics as an influence on technology usage among seniors. For example, in research with older adults in the U.S., Vroman, Arthanat & Lysack (2015) found that higher education, living with a spouse or partner and personal attitudes such as having a positive outlook on life were all positively associated with IT usage. Butt and Phillips (2008) conducted quantitative research with a sample of more

than 100 Australian mobile phone users of all ages, and found evidence of the impact of personality traits on usage levels and communication patterns.

The Influence of Culture and Language on Technology Adoption

One of the main criticisms that have been made about leading theories of technology adoption is that they fail to take adequate account of the impact of contextual factors such as language and culture (Aldhaban, Daim & Harmon, 2015). Researchers have argued that since these models were developed in Western developed countries, they may not be applicable to non-Western environments because of the influence of these types of factors (Ameen & Willis, 2015; Hill, Loch, Straub, & El-Sheshai, 1998).

A number of previous studies have demonstrated the impact of cultural factors on the adoption and use of technology, in a range of settings (e.g. Barton 2010; Hofstede 1980; Trompenaars & Hampden-Turner 1997). Culture is generally defined in terms of the beliefs, norms, values and practices that are dominant in a society, and which reflect acceptable ways of thinking and responding to events in this setting (Al-Jumeily & Hussain, 2014; Schein, 2010; Schwartz, 2006). Many researchers have used Hofstede's (1980) dimensions of national culture as a tool to compare technology usage between countries. Defining culture as "the collective programming of the mind which distinguishes the members of one human group from another" (p. 9), Hofstede (1980) identified five main dimensions which reflect the characteristics of national cultures, and conceptualized each of these in terms of a continuum on which countries can be placed depending on their specific cultural characteristics. These dimensions were defined as *power distance*, or the extent to which power and authority are distributed equally or unequally within society; *individualism versus*

collectivism; masculinity versus femininity (the relative dominance of “masculine” traits such as competitiveness or assertiveness, versus “feminine” traits such as sensitivity and modesty); *uncertainty avoidance* or the extent to which risk is tolerated, and *long-term versus short-term orientation* (Hofstede, 1980). Ribière, Haddad, & Philippe (2010) drew on these dimensions, along with concepts drawn from theories of technology adoption and other factors, to compare the use of Web 2.0 technologies between countries. They found that the factors that were significant in predicting Web 2.0 use included uncertainty avoidance, ways of maintaining relationships; online privacy concerns; perceived usefulness of the technology, and long-term orientation. In other words, this study demonstrated that technology adoption models do not adequately capture the variation between countries, and there is a need to incorporate cultural measures in order to understand this. Rose & Straub (1998) found evidence that although the Technology Adoption Model (TAM) could be applied successfully in the Arab world, they cautioned that their findings did not take into account the impact of culture. Similarly, Baker et al. (2007) tested the Theory of Planned Behavior (TPB) as a model explaining attitudes to the use of computers among a sample of Saudi Arabian knowledge workers. They found that the TPB variables *attitudes towards technology*, *subjective norms* and *perceived behavioral control* were all significant influences on intentions to use technology among this sample, but that these variables only accounted for 37% of the variance in intention to use computers among this sample. Aldhaban, Daim and Harmon (2015) argued that there has been insufficient research that has comprehensively examined the factors influencing the acceptance of technology in Saudi Arabia (Aldaban, Daim & Harmon, 2015). However, studies of the adoption of mobile Internet (Alwahaishi and Snášel, 2013) and e-services (Al-Ghaith, Sanzogni, & Sandhu, 2010) in Saudi Arabia

have demonstrated that factors including social influences, facilitating conditions, and language have an important impact on technology adoption and use in this setting.

Saudi Arabia is a conservative country, where the culture is strongly influenced by both Islamic teachings and Arab traditions (Baker, Al-Gahtani & Hubona, 2007). Its dominant cultural traits in terms of Hofstede's national culture dimensions are high risk-avoidance, high power distance, and collectivism, traits which together mean that social influences have a strong impact on technology adoption behaviors in this society (Ameen & Willis, 2015). It has also been widely defined as a "high context" culture in which close personal relationships built on trust are very important, and which provide the context for indirect and implicit communications based on short, situation-dependent messages (Zakaria, Stanton & Sarker-Barney, 2003). These cultural characteristics of Saudi Arabia have a number of implications for the adoption of smart phones and other forms of personal technology.

First, the Internet and social media have largely been seen in terms of Western influences, which present potential threats to the traditional religious and cultural values and social structure of Saudi Arabia (Al-Shohaib, Al-Kandari & Abdulrahim, 2009; Emdad, Badamas & Mouakket, 2009; Rose & Straub (1998). In particular, concerns have been raised about the ways in which social media and online communications provide opportunities for direct contact between the sexes in this strictly gender-segregated society (Al-Saggaf, 2004). As a result, the government has implemented heavy censorship of the Internet within Saudi Arabia (Albugami & Ahmed, 2016).

Second, the high level of uncertainty avoidance in Saudi Arabian culture has been reflected in the findings of research showing that individuals in this setting tend to delay

adopting new technologies or the use of online services such as e-commerce and mobile banking, until these practices are well established in society (Al-Gahtani et al., 2007; Belkhamza & Wafa, 2009; El Said and Galal-Edeen, 2009). Since Saudi Arabia is a collectivist rather than an individualist society, these social influences on the adoption of technology are even more significant, with individuals unlikely to adopt new technologies unless these are recommended by trusted personal contacts (Ameen & Willis, 2015). In this context, older Saudi Arabians are even less likely to be early adopters of technology according to Roger's (2003) Diffusion of Innovations Model, which showed that early adopters tend to be younger individuals. Uncertainty avoidance has a particularly strong impact on the likelihood of using online services because of concerns about privacy and security issues. Shafi (2002) conducted research with a sample of Saudi business organizations and found that they mainly use the Internet only for tasks like communications and research, being deterred from adopting e-commerce by security concerns. Al-Ghaith et al (2010) argued that, in order to encourage the use of e-commerce in Saudi Arabia, there is a need to implement measures that reduce uncertainty, particularly in the areas of improved security and privacy, a recommendation that can be extended to the design of smart phones and applications.

Third, the high-context culture of Saudi Arabia includes a preference for face-to-face or other real-time forms of communication, and a reluctance to change traditional habits and values (Ameen & Willis, 2015; Hill et al., 1998; Jumeily & Hussain, 2014). The impact of these cultural factors on the adoption of smart phones and other personal technology is complex, however, and can both hinder and promote their use (Ameen and Willis, 2015). On the one hand, research has revealed that the mobile phones are widely used in Saudi Arabia

and are valued for the ways in which they enable relatives and friends to stay in regular contact, supporting the collectivist aspects of the culture (Aldhaban et al., 2015). It is also reported that text messaging is frequently used in the context of Islamic celebrations (Ameen and Willis, 2015). On the other hand, the use of mobile phones and smart phones has been seen as a threat to traditional Saudi Arabian culture due to the ease of text messaging and exchanging images and videos between males and females, and because of their role in spreading political messages in the Arab Spring uprisings across the wider Middle East region (Ameen & Willis, 2015).

As well as these cultural characteristics of Saudi Arabia, language is another aspect of this setting that may have an influence on the adoption of smart phones and other personal technologies. Arabic is the first language of the Saudi Arabian population, but most technology interfaces and contents are designed primarily for English language speakers (Al Ghaith et al, 2010). As a result, researchers who have examined the adoption of e-services in Saudi Arabia have concluded that language is a major obstacle to this development (Al Ghaith et al, 2010), and this may also be true of smart phone adoption. In general, researchers have observed that, across various countries, those with a good command of the English language are more likely to be early adopters of new technology.

Language is also a very important component of culture in which dominant norms and values are both reflected and transmitted, and which takes a variety of grammatical and non-grammatical forms. Barber and Badre (1998) developed the design concept of cultural markers (Barber and Badre, 1998), which include colors, icons, metaphors, language, layout, graphics and textual symbols, and which can be used to reflect dominant cultural characteristics in a particular society or group, when designing technology for use in that

setting. It has been argued that many forms of technology have Western cultural biases in their design that may prevent barriers to their adoption in non-Western countries (Al Jumeily & Hussain, 2014; Hill et al., 1998). Studies have shown that individuals are most likely to do adopt technology and electronic services if they perceive these to be compatible with their own culture and language (Al Ghaith et al, 2010; Tan & Teo, 2000).

Smart Phone Usage among Older Adults

The review of literature revealed a number of empirical studies of the specific ways in which older adults use smart phones and other new technologies, and the factors influencing patterns of technology use. In the United States, for example, the Center for Research and Education on Aging and Technology Enhancement's survey of 1,204 individuals aged from 18 to 91 found that older adults were in general less likely than younger people to use computers and other devices. However, another U.S. study conducted by Olson, O'Brien, Rogers and Charness (2010), which compared patterns and frequency of technology usage between younger and older adults based on a sample of 681 individuals, found that age-related differences depend on the specific technology being used, i.e., there was no evidence from this study of a general aversion to technology among seniors. The researchers concluded that older adults tend to be more selective in their use of technology and are slower to adopt new forms (Olson, O'Brien, Rogers and Charness, 2010). This is consistent with the findings of a study by the Pew Research Center that once older users experience use of the Internet, they quickly become frequent users (cited in Lichtenstein, 2013). Mitzner et al. (2010) conducted focus groups to explore older adults' attitudes to technology, and found that positive views and recognition of the benefits of technology outweighed negative

attitudes among the participants. The benefits of technology usage identified by the participants included convenience, support for their activities and useful functions, while negative attitudes related to inconveniences resulting from use of the technology, unhelpful functions and concerns about security (Mitzner et al., 2010).

Several studies were identified that examined the functions that seniors use on their smart phones or mobile phones. In general, these generated similar or consistent findings even though they were conducted in a range of different country settings. In particular, the studies reveal that seniors tend to use a limited range of functions on their phones, either because of their perceived complexity, or because they do not see the benefits of doing so (e.g. Lee, 2007).

One of the most detailed studies of smart phone use among older adults was conducted in Spain by Rosales & Fernández-Ardèvol (2016). In this research the behaviors of a sample of smartphone users aged 20 to 76 were tracked for one month and follow-up focus groups were conducted with participants aged between 55 and 81. The researchers concluded that older adults are increasingly using smartphones but the overall extent of smart phone application usage declines with age. They also reported differences in the types of applications being used by older and younger smartphone users, with seniors more likely to use personal information manager applications such as calendars, address books and notes. However, the messaging tool WhatsApp was found to be the most popular and used by participants of all ages, including seniors.

In a mixed-methods study conducted in Hong Kong, Chen, Chan & Tsang (2013) a questionnaire survey and focus groups were used to explore the use of mobile phones among older adults. The findings revealed that participants mainly used basic features of their

phones such making and receiving calls, the address book, alarm, the time and date display, emergency panic button, and camera. The participants reported that keeping in touch with people close to them was the main perceived benefit of their phone, but the researchers reported that participants also frequently used their phones for locating information such as addresses, telephone numbers, and the time or date. In a later study, Chen, Chan & Ma (2014) used a paired-comparison method to identify the mobile phone features regarded as most useful by older users. The calling function was given highest priority, followed by the phone book, clock, emergency button, alarm, camera and calculator. The participants gave lowest priority to the SMS function. The researchers concluded that, in general, the phone functions requiring the lowest mental effort are preferred by seniors. However, based on the findings of a survey conducted among seniors in Norway, Dale and Schulz (2011) found evidence of interest among this group in using smart phones as a payment method, for GPS navigation and for obtaining health information.

Guidance on Smart Phone Design for Seniors

A substantial body of academic literature in this area contains practical research-based guidance and recommendations on developing smart phone interfaces and other forms of technology for use by older people. This literature is based on a range of methods including systematic reviews and empirical research with older adults. For example, Hawthorn (2000) carried out a comprehensive review of more than 100 previous studies relating to ageing and technology interface design, and developed recommendations for the design of smart phones based on the insights and best practice revealed by his review. Strengers (2012) developed recommendations for smartphone interface design by conducting

a questionnaire survey of smartphone users aged over 60, and evaluating a new design informed by the survey findings. Fisk et al. (2009) is one of the most widely cited sources of detailed guidance on ageing and technology design, which is based on focus groups research and an integration of key findings from existing literature. Fisk et al. (2009) highlight the importance of taking into account changes in perceptual, cognitive and motor systems when designing any form of technology for older people. Based on their focus groups with seniors, they found that 47% of the difficulties that older people face when using technology is related to financial, health related or other general concerns. Of the remainder, they concluded that 25% can be remedied by improved design of systems, and that the rest can potentially be resolved by training or a combination of training and design modifications.

Despite the existing guidance in this area, there are still significant gaps between theory and practice in the area of smart phone design. Leitão & Silva (2012) observe, for example, that the phone Operating Systems (OS) guidelines published by Apple, Google and Microsoft are not tailored to the needs of specific groups such as seniors. The recommendations arising from the many studies in this area can be summarized within categories relating to the various types of challenges which older adults face when using smartphones, and which are discussed in turn in the sub-sections below.

Visual Aspects of Interface Design

Fisk et al. (2009) note that age-related changes in vision often begin in early middle age, around 30 to 40 years. Since most of the information on smart phones is conveyed visually, it is essential that interfaces be designed to address these changes (Pak & MacLaughlin, 2010). Specific recommendations include clarity and simplicity of layout that

enables users to find functions easily and retain a focus on them. This includes the use of a bright screen, large font size (e.g. at least 12-14 pixels in Sans-serif fonts), clear contrast (e.g. black text on white background) and easy to read buttons. The design should avoid the use of moving graphics, flashing text, overlapping elements, minimize features at the edge of the screen and include generous spacing between items. Icons might be used along with text to explain button functions (Barros, Leitão & Ribeiro, 2014; Hawthorne, 2000; Sharma et al., 2012).

Audio Aspects of Interface Design

Auditory changes are common among older individuals, especially males and those at more advanced ages (Fisk et al., 2009). Therefore, higher volume sounds should be used in the design of smart phones for this group (Chen et al., 2013); Hawthorn (2000) also found that the use of lower frequency sounds facilitates the use of smart phone among older users. However, auditory features such as the use of speech-based interfaces can be used to compensate for visual difficulties among this group (Hawthorn, 2000).

Psychomotor Aspects of Interface Design

The control of movement by the brain also slows as people age, along with other changes in cognition and memory that affect smart phone use (Fisk et al., 2009). One type of age-related cognitive change that most affects smart phone use is a decline in working memory. This affects, for example, the ability to navigate complex menus, interpret information on a visual display, remember sequential steps in procedures and select from options in an auditory menu (Fisk et al., 2009). To compensate for declines in working

memory, Hawthorn (2000) recommended that there should be few delays in the flow of task, that interfaces should be kept simple to avoid distractions, and that concrete representations should be used instead of relying on the individual's memory.

Cognitive decline also affects the speed and accuracy of physical movements, and many researchers have made recommendations for smart phone design that compensate for these types of changes. For example, Hawthorn (2000) recommends that timing of required actions should be slowed and larger targets used. As mentioned earlier, there is little consensus among researchers about whether keypads (e.g. Cullen & Bratteteig, 2013; Laguna, 2008; Sharma et al., 2012) or touchscreens (e.g. Dale & Shulz, 2011; Häikiö et al., 2007; Kobayashi et al., 2011) are preferred for use by older users, but there is a general agreement that keys or touchpad buttons should be relatively large: based on their interviewees with older smart phone users, Muraa & Iwase (2005) and Jin et al. (2007) recommend based on experimental research with seniors that touch panel buttons should be at least 16.5 x 16.5 mm in size, with a spacing between buttons of between 3.17 mm and 12.7 mm (Jin et al., 2007), although others have suggested that button sizes of at least 8 mm in width are sufficient (Kobayashi et al., 2011). It has also been suggested that drag and pinch gestures are easier for seniors to use than touchscreen taps (Kobayashi et al., 2011). Other recommendations include simple menus with relatively few choices and language-based error correction (Nicolau & Jorge, 2012). Motti, Vigouroux & Gorce (2015) found that drag and drop interaction is improved among older users by decreasing accuracy requirements from 95% to 80%.

Overall Design and Features of Smart Phones

There is a general consensus among researchers that smart phones for elders should retain critical features while eliminating unnecessary functions in order to maintain simplicity (Sharma et al., 2012). In particular, the most important features shown to be popular with older users include the call function, time and date, address book, camera and alarm (Chen et al., 2013). Based on interviews with expert informants in the area of smart phone design for seniors, Kurniawan (2008) suggests incorporating an emergency button; control buttons for important functions; a hard sleeve to protect against accidental activation of functions; the ability to activate a strong backlight, a voice recorder and a photo-based caller ID.

Leung, Findlater, Mcgrenere, Graf & Yang (2010) conducted a controlled experiment that investigated the use of a multi-layered interface smart phone by a group of older participants aged 65 to 81, and a group of younger participants aged 21 to 36. This involved initially using a reduced functionality interface layer allowing only basic tasks, then progressing to a more complex interface layer. They found that the reduced functionality layer helped older adults in particular to learn and retain the ability to carry out the basic functions, and that when progressing to the advanced layer, there was no negative impact on these abilities. The researchers found that most of the older participants preferred the use of the multi-layered interface when learning to use a smart phone (Leung, Findlater, Mcgrenere, Graf & Yang, 2010).

Fisk et al. (2009) distinguish between the *utility* of a technological device, which refers to whether it provides what is needed, and the *usability*, which refers to the ease with which individuals can access its functionality. They identify four main user-centered design

principles that are recommended for use when designing technology for older adults: 1) an early focus on the user and the tasks they will perform with the device; 2) empirical research in the form of questionnaires, surveys and usability testing studies; 3) an iterative process of design and testing, and 4) and integrated and well-coordinated design processes.

User Involvement and Training

Several sources emphasize the importance of involving older adults in all stages of the design process, including the testing of prototypes, when developing smart phone interfaces tailored to their age group (Bjering et al., 2014; Chen et al., 2013; Fisk et al., 2009). This is especially important in the early stages of design to build on the mental models and procedures already learned by this group when using mobile phones and other forms of technology (Fisk et al., 2009). Cullen & Bratteteig (2013) point out that, in technology design, family members or other representatives often represent the interests of vulnerable people including the elderly, but the interests of these representatives may sometimes be in conflict with those of the target group. It is therefore essential to involve senior citizens directly in research to inform the design of smart phone interfaces.

The availability of relevant training and guidance is also important for overcoming the anxiety and lack of confidence that many seniors, especially women, experience when using smart phones or computing devices (Czaja et al., 2006). Arenas-Gaitan (2013) stresses that access to technology will not in itself provide benefits to older people, there is a need to possess skills for “searching, navigating, sorting, filtering, and utilizing Internet information”. Research with seniors using handheld touchscreen devices (Barnard, Bradley,

Hodgson & Lloyd, 2013) revealed that participants had three preferred learning styles: having someone teach them step by step; trial and error, and reading a manual or instructions.

Use of Technology and Smart Phones in Saudi Arabia

No literature was located in the review that examined the use of smart phones or other new technologies among seniors in Saudi Arabia, or in other Middle Eastern countries, the vast majority of research conducted in this area has been carried out in western, developed countries. A small number of studies were identified that examined technology adoption and smart phone usage in Saudi Arabia, but which did not focus specifically on seniors. These are briefly discussed because they provide insights relevant to the design of smart phones for seniors that take into account language and cultural factors relevant to Saudi Arabia.

Al-Gahtani (2008) confirmed the applicability of the TAM model in the Arab context based on a questionnaire survey of 722 knowledge workers using desktop computers in Saudi Arabia. The study found that age is the most significant factor moderating the influence of perceived usefulness and perceived ease of use on attitudes to technology and intention to use. In contrast, gender and education only had a moderating impact between perceived ease of use and attitudes to technology. In an earlier study of the impact of cultural factors on the acceptance and use of technology in Saudi Arabia, Al-Gahtani, Hubona, and Wang (2007) had discovered that subjective norms have a positive influence on the “intention to use” technology variable.

To address the ways in which TAM models frequently exclude consideration of individual and social factors in the technology adoption process, Aldhaban, Daim and Harmon (2015) explored the impact of the Saudi Arabian cultural and social context on the

use of smart phones in this environment. The intention of the authors was to develop a new theoretical model for use in Arabic settings based on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The study revealed in particular the role of language as a factor influencing take up of smart phones in Saudi Arabia, since smartest phone interfaces and content are designed primarily for English-speaking users.

Khasawneh (2014) examined in detail the role of language in smart phone adoption and usage among Arabic-speaking users. The sample consisted of 117 college students aged between 18 and 23. All of the participants suggested design modifications to improve usability and acceptability of smart phones among Arab users. Based on the results, the researchers set out a number of specific recommendations for an Arabic user interface (UI) including consistency of the UI across all devices and operating systems; availability of translation features; ability to change typing direction and ability to use of a variety of fonts.

Finally, Al-Mouh & Al-Khalifa (2015) investigated the use of smart phones among a sample of Arabic-speaking visually impaired people in Saudi Arabia. They found that 83% of participants were using an Arabic user interface and 91% were using touch screen phones due to the availability of Arabic support and the advanced features available on these phones. The vast majority were using iPhones because the screen reader of these phones supports Arabic. Most of the participants reported using their phone mainly to connect with others and to use the Internet.

Chapter Summary

This chapter has presented a review of literature relevant to the understanding of smart phone use among senior citizens in Saudi Arabia. Overall, relatively few studies were identified that specifically investigated smart phone use among older adults, and the review has therefore drawn extensively on studies based on the adoption and use of new technologies in general, as well as smart phones in particular, among this group. This finding supports the claims of other researchers that there has been insufficient research to date investigating the usability of smart phone interfaces for senior citizens (Barros et al., 2014; Kobayashi, 2011; Strengers, 2012).

Very few studies were identified that have specifically examined the use of smart phones among senior citizens in Saudi Arabia, and the majority of research in this area and used to inform design recommendations has been conducted in western, developed countries. It is not known whether there are differences in the need for and use of smart phones among older adults in Muslim Middle Eastern societies compared with seniors in western countries and, if so, whether these have implications for the design of smart phone interfaces needed to address the needs of this group. The findings of the literature review thus reveal a knowledge gap relating to smart phone use among senior citizens in Muslim Middle Eastern societies and support the need for the current study. Conducting research in this area will be important to ensure that older people in Muslim Middle Eastern societies have the opportunity to benefit from the potential health and quality of life benefits offered by smart phone use which have been documented among seniors in other settings.

CHAPTER 3. METHODS

The research consists of a mixed-methods empirical study of attitudes towards and the use of smart phones among a sample of senior citizens in Saudi Arabia. Data collection methods consisted of an initial interview survey of senior citizens in Saudi Arabia, a user evaluation of a prototype smart phone application, and in-depth interviews. It has been conducted within a theoretical framework based on the Technology Adoption Model (Davis, 1989). Under this model, the variables *perceived usefulness* (PU), and *perceived ease of use* (PEOU) both have an influence on an individual's attitude to a particular technology, and this predicts their behavioral intention to use the technology, which in turn predicts actual usage. Within this theoretical framework, empirical research is important in order to understand perceived usefulness and perceived ease of use of smart phones among seniors in Saudi Arabia, and to determine what design modifications are likely to increase the take-up of smart phones among this group.

Saudi Arabia has been chosen for the study for a number of reasons. First, research with younger adults (Aldhaban et al., 2015) and with visually impaired people (Al-Mouh & Al-Khalifa, 2015) in Saudi Arabia has highlighted the need to modify smart phone interfaces to the local culture and language there. Second, no previous research has examined the use of smart phones among seniors in this setting, and it is not known how smart phone interfaces need to be adapted to the needs of this specific group. Third, Saudi Arabia is broadly representative of other relatively affluent Muslim countries in the Gulf region of the Middle East, such as Bahrain, the United Arab Emirates and Oman, where the Islamic religion and Arabic language are also dominant. This means that the findings may be of wider interest across this region. Finally, the investigator is a Saudi Arabian national and has an extensive

network of contacts there, which was used to gain access to the research samples. This has facilitated the fieldwork processes and helped to secure high levels of participation.

Participants and Recruitment

Participants consisted of Saudi Arabian nationals living in the Kingdom of Saudi Arabia (KSA) aged 65 or over, including both males and females. Individuals who were current users of smart phones as well as those who did not own a smart phone at the time of the study were eligible for inclusion in the survey and prototype evaluation, since these were concerned with understanding attitudes to smart phones among all Saudi Arabian senior citizens and the reasons why some individuals were not currently using this technology. Only current users of smart phones were eligible for participation in the third stage semi-structured interviews, which explored experiences of and attitudes to smart phone use among those with first-hand experience of this technology.

In order to gain access to senior citizens in the KSA for the first stage interview survey, the investigator requested friends and other personal contacts to ask their relatives aged 65 or over to take part. A short flyer was designed to provide information about the study to the potential participants; this was emailed to the potential participants in advance by the researcher or handed out by the researcher's personal friends and other contacts to their elderly relatives. If these seniors expressed willingness to take part in an interview or to find out more about this stage of the study, the investigator contacted them by telephone to explain further what they would be required to do, answer any questions, and arrange an appointment for them to take part in a face-to-face interview. Once individuals had taken

part in the study, they were asked to refer others who met the eligibility criteria to the researcher, in a process of "snowballing", until a satisfactory sample size was reached.

For the second stage of the research, the prototype application evaluation, the sample of seniors who participated in the initial questionnaire survey research on smart phone use were first asked if they would be prepared to participate in the trial. As in the first stage of the study, the investigator's personal friends and other contacts were also requested to ask their own relatives aged over 65 if they would be willing to be participate in the study and share their experiences of using the prototype application interface. The individuals who expressed willingness to take part or to find out more about the study were contacted by the investigator to explain what they were required to do, answer any questions, and arrange an appointment for them to participate in an interview or trial the prototype application. The original target sample size for each stage of the research was 100 participants, however, this proved impossible to achieve within the available timescale for fieldwork. Sample sizes of 45 participants for the interview survey and 41 for the prototype trial were achieved, which are considered to be adequate for the purpose of the study.

For the third stage semi-structured interviews, the investigator again requested friends and other personal contacts to ask their relatives aged 65 or over, who were currently smart phone users, to take part. Initially, this convenience sampling approach was used to generate a sample of 10 current smart phone users for the purpose of interview.

Participation in each stage of the study was completely voluntary, and all participants were asked to sign an Informed Consent Form.

Data Collection

A semi-structured survey questionnaire was used for data collection in the first two stages of the research (survey and prototype evaluation), facilitated by use of the SurveyMonkey online software. Since the research was conducted with older Arabic-speaking individuals who might not be familiar with the use of online survey software, face-to-face interviews were used, in which the researcher read the questions and range of possible responses to the participants in Arabic, and then directly input their answers into the survey database in English. Interviews were conducted at a venue chosen by the participant, such as their own home, the investigator's home or the local mosque.

The use of structured questions enabled quantification of particular types of responses relating to the use of and attitudes towards smart phones, while the inclusion of semi-structured open-ended questions enabled the researcher to capture additional insights into the participants' own words. A full copy of the questionnaire used in the first stage of data collection is attached as Appendix A; this covered the following main topics:

- Whether the individual currently uses a smart phone and, if so, which brand and model.
- For participants currently using a smart phone:
 - How long they have owned their current smart phone
 - How long they have been using any form of smart phone
 - Perceived importance of various factors listed when purchasing a smart phone.
 - Frequency of use of listed features of their smart phone
 - Experiences and frequency of difficulties when using smartphone features

- Perceived overall ease of use
- Additional features they would like the smart phone to include
- Any health-related problems affecting smart phone use
- For participants not currently using a smart phone:
 - Whether they use another type of mobile phone
 - Reasons why they do not use a smart phone
 - Expected use of various functions if given a smart phone
 - Expected future purchase of smart phone
 - If buying a smart phone, perceived importance of various factors
- Demographic information
- Overall use of and confidence in technology

For the purpose of the prototype evaluation, each participant was provided with the use of an iPhone on which the prototype application had been installed. They were given brief instructions by the researcher on how to navigate the application and asked to spend around 15 minutes independently exploring the application and using its functions. The researcher then interviewed them in Arabic by reading out each question and range of possible responses from the prototype trial questionnaire, and input the participants' responses direct to the research database in English using the SurveyMonkey electronic survey software.

A full copy of the questionnaire used for the prototype application evaluation is attached as Appendix B; this covers the following main topics:

- Likelihood of using this type of application

- Willingness to pay for this type of application
- Perceived popularity of the application among Saudi Arabian senior citizens and younger Saudi Arabians
- Perceived popularity of the application among senior citizen pilgrims, and younger pilgrims
- Perceived ease of use of specified functions and features of the application
- Perceived standard (e.g. very good, poor) of specified functions and features of the application
- Views on the simplicity/complexity of information in the application
- Views on the accuracy of information in the application
- Preferred changes or additions to the application
- Other comments on the application

The third stage semi-structured interviews were conducted face-to-face with participants at a venue of their own choosing, such as their home or the mosque. The interviews were audio-recorded and were subsequently transcribed and translated into English for the purpose of analysis. After signing the consent form, each participant was interviewed in Arabic by the investigator using a semi structured interview guide. However, since this stage of the study used a qualitative approach, the interviews were relatively informal and the participants were asked to provide and explain their responses in their own words. At times, the interviewer varied the wording of interview questions to tailor these to individual participants, and included additional questions or probes as necessary to explore

the participants' views and experiences in depth. The main topics covered in the interviews consisted of:

- Detailed descriptions of smart phone usage
- Reasons for first using a smart phone, and level of confidence/familiarity with computer technology at that time
- Detailed descriptions of any challenges encountered when first using a smart phone and changes in feelings about smart phone use over time
- Views on suitability of smart phone for older user in Saudi Arabia and suggested improvements
- Perceived reasons why some older people have limited or no use of smart phones
- Suggested ways of encouraging more seniors in Saudi Arabia to use smart phones
- Perceived cultural or religious barriers to the use of smart phones among seniors in Saudi Arabia
- Perceived language barriers to the use of smart phones among seniors in Saudi Arabia.
- Views on the relative merits of smart phones and other methods of communicating with family and friends
- Views on the benefits and drawbacks of using smart phones to search the Internet
- Views on the benefits and drawbacks of using smart phones to access government or private sector services.

Data Analysis and Interpretation

Data from the structured survey questions on the participants' experiences of and views on smart phones were translated into English and analyzed using simple descriptive statistical techniques to determine the frequencies and distribution of responses to the interview questions. This enabled the investigator to identify the ways in which Saudi seniors use smart phones and their views on and experiences of using them, based on the study sample. The results are presented in charts as well as in narrative format in Chapter 4.

The qualitative (textual response) data from the open-ended questions (e.g. "other, please specify") were read, sorted into categories of similar responses, and included in the analysis narrative. Other qualitative data were also translated into English and analyzed using thematic analysis to provide further insights into Saudi seniors' experiences of smart phone use. The findings are only reported in aggregate form and not attributed to individual participants, who are not therefore identifiable from the findings.

Implications and recommendations for the prototype design were identified from the initial survey findings, and a prototype religious application was designed for use by the target user community using smartphones was developed in accordance with these findings. This application is described in more detail in Chapter 5. The prototype was tested on a sample of research participants and their experiences and views are presented in Chapter 5, in the form of narrative and charts.

The qualitative data generated from the semi-structured interviews was analyzed using thematic analysis methods, structured by the use of a theoretical framework based on models of technological adoption and a review of relevant literature. The initial coding of data was facilitated by use of the NVivo 11 qualitative analysis software. A combination of

inductive and deductive coding was used, with codes and sub-codes being identified from the data itself but also from the theoretical framework. The findings are presented in Chapter 6 by key themes, illustrated by verbatim quotes from the interviews, to preserve as closely as possible the personal experiences and views of the participants as reported in their own words.

The key findings from each stage of the study were incorporated into a final set of recommendations for a smart phone interface designed for use by senior citizens in Saudi Arabia and in other Arabic-speaking, Muslim countries of the Middle East. These recommendations are presented in Chapter 7, along with discussion of the overall contributions of the study and their wider implications. In this way, the findings from the various stages of this mixed methods study are synthesized in the discussion of findings in order to provide a full understanding of their overall relevance and implications in relation to the objectives of the study and the research questions.

CHAPTER 4

SURVEY RESULTS

This chapter presents the results of an empirical study conducted for the purpose of investigating attitudes to and use of smart phones by senior citizens in Saudi Arabia. The objective of the study is to identify the functionalities and features needed to promote the more rapid take-up of smart phones among this group, as well as any barriers to their use that need to be addressed, so that senior citizens in Saudi Arabia are able to better access the benefits of smart phone use among for older people that have been documented in other countries. This chapter presents the findings relating to Research Questions 1, 2, and 6 using data from a semi-structured interview survey with a sample of senior citizens in Saudi Arabia. These questions are:

1. What are the characteristics of smart phone usage among senior citizens in Saudi Arabia?
2. What types of difficulties do senior citizens in Saudi Arabia experience when using smart phones?
3. What features should be included in a smart phone interface designed for use by senior citizens in Saudi Arabia, that will help increase the rate of smart phone adoption by this group?

Characteristics of Participants

Demographic Characteristics

The sample consisted of 45 senior citizens living in the Kingdom of Saudi Arabia (KSA), and was generated using purposive and snowball sampling methods.

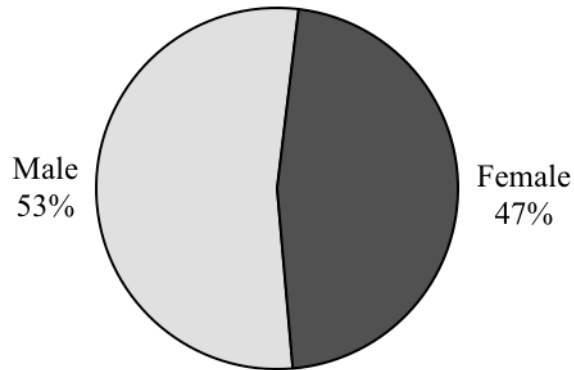


Figure 1: Distribution of the sample by gender (N=45). The achieved sample of 45 was roughly split between males (53%, N=24) and females (47%, N=21). All were aged over 65, since this was a requirement for participation in the study. The vast majority reported their marital status as “married” (78%, N=35); of the remainder, most were widowed (20%, N=9), while just one participant was divorced.

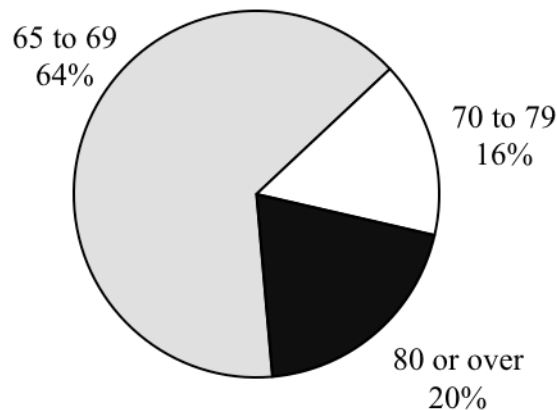


Figure 2: Distribution of the sample by age (N=45)

The age distribution of the sample is shown in Figure 2: almost two-thirds (64%, N=29) were aged 65 to 69, 16% (N=7) were aged 70 to 79 and 20% (N=9) were aged 80 or over. The sample therefore represents a wide age range within the population of senior citizens in Saudi Arabia.

Similarly, people with different levels of education were well represented in the sample. However, the distribution of respondents by educational level was very different for males and females (Figures 3 and 4), reflecting the historically lower levels of participation in higher education among women in Saudi Arabia.

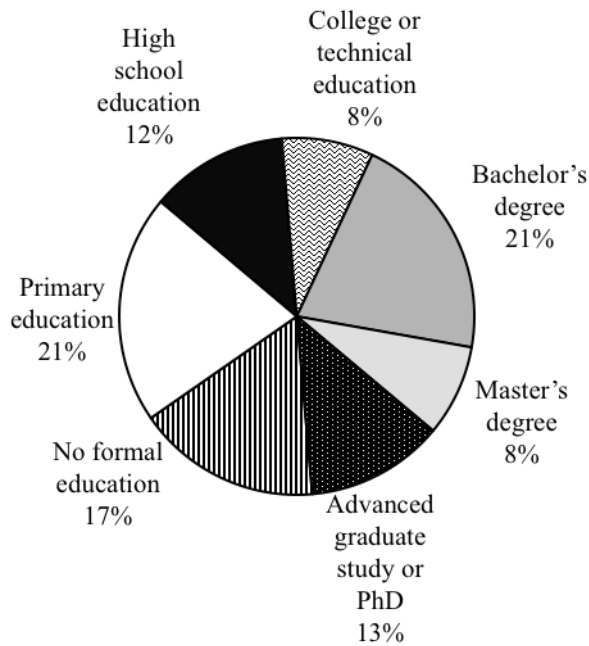


Figure 3: Distribution of males in the sample by highest educational level (N=24)

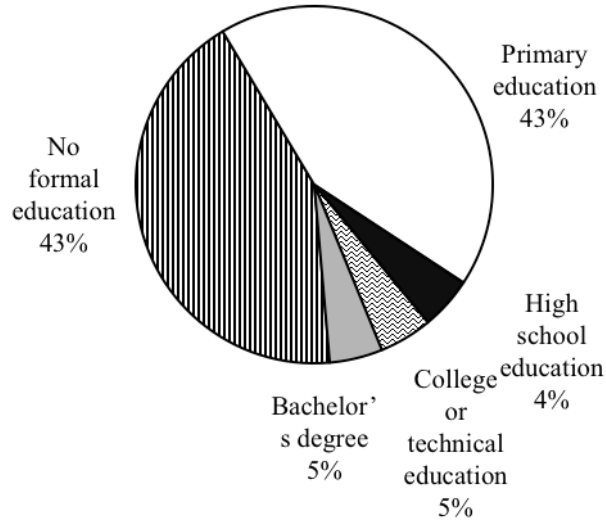


Figure 4: Distribution of females in the sample by highest educational level

In the case of the male participants, more than 40% in total reported that they were educated to Bachelor's degree level or above, while at the other extreme 17% indicated that they had no formal education and 21% said they had only attended primary school (Figure 3). In contrast, among the female participants only one respondent (5% of the sample) reported being educated to university level, while 43% (N=9) had no formal education and another 43% (N=9) had only attended primary school (Figure 4).

Although the relatively small size of the sample did not allow for the use of statistical techniques to examine the relationship between demographic variables, such as gender, age and education, and smart phone use, having a diverse sample at least means that the study reflects a range of different perspectives and experiences of the use of smart phones among Saudi Arabian senior citizens.

Attitudes to Technology

The questionnaire also collected information on the participants' general attitudes to and use of personal technologies, in order to explore the ways in which these might influence their attitudes towards smart phones and their experiences of using these devices.

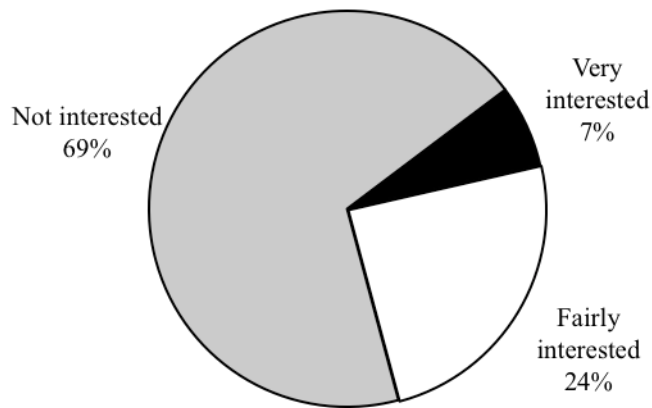


Figure 5: Distribution of the sample by level of interest in latest technologies (N=45)

Respondents were first asked to rate their level of interest in learning about the latest technologies and the overall distribution of responses is shown in Figure 5. The majority of the senior citizens in this sample (69%) reported that they are “not interested” in learning about the latest technologies. Only 7% (N=3) indicated that they are very interested in learning about the latest technologies, while the remainder reported being “fairly interested”.

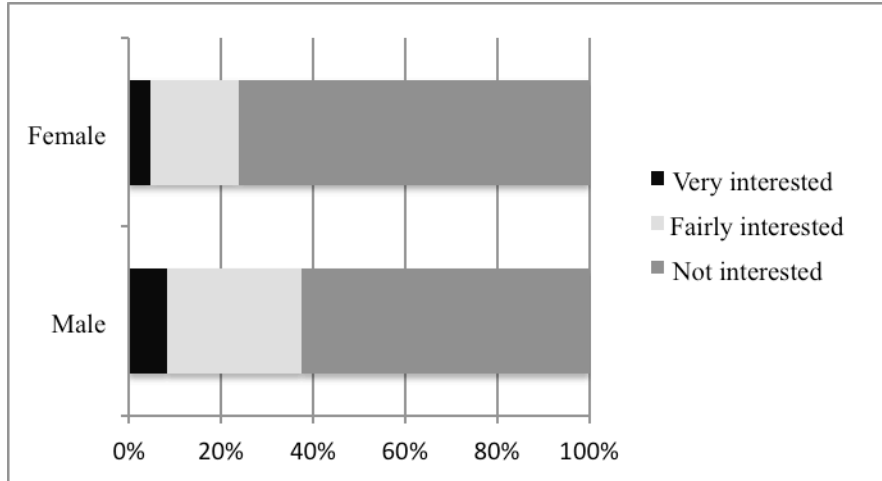


Figure 6. Interest in learning about latest technologies, by gender (N=45)

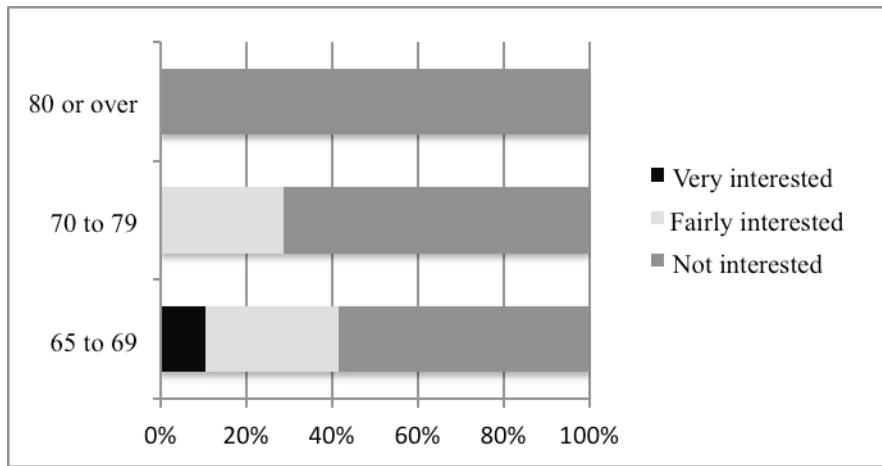


Figure 7. Interest in learning about latest technologies, by age (N=45)

The data was investigated further to identify any apparent differences in levels of interest in learning about the latest technologies by gender, age or educational level and the results are shown in Figures 5, 6 and 7. These charts show the percentage distribution of responses for each sub-group.

The findings revealed that, despite differences in educational characteristics of the sample between men and women, there was relatively little difference by gender in levels of interest in learning about the latest technologies. Overall, 37% of males in the sample (N=9) and 24% of the females (N=5) indicated that they are either “fairly” or “very” interested in learning about the latest technologies and while the remaining majorities of both males and females indicated that they are “not interested” (Figure 6).

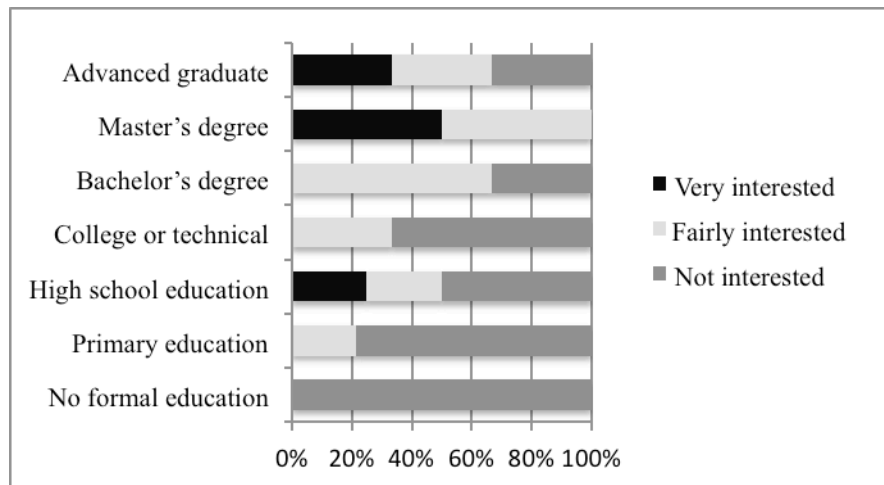


Figure 8. Interest in learning about latest technologies, by educational level (N=45)

Figure 7 reveals, however, that all of those respondents who reported being “very interested” in learning about the latest technologies were among the youngest age group (65 to 69), and that all of those in the oldest age group (80 or over) indicated that they were “not interested”. Finally, Figure 8 suggests that there is an association between educational level and level of interest in learning about the latest technologies at the level of the whole sample (though the sample size is too small to prove this statistically), with the majority of those indicating that they are “very interested” having advanced graduate degrees or Master’s degrees. Overall, these findings suggest that a lack of interest in technology may represent a

barrier to the use of smart phones among older people in Saudi Arabia, especially among those with lower levels of education, a point which will be addressed further in the Discussion chapter.

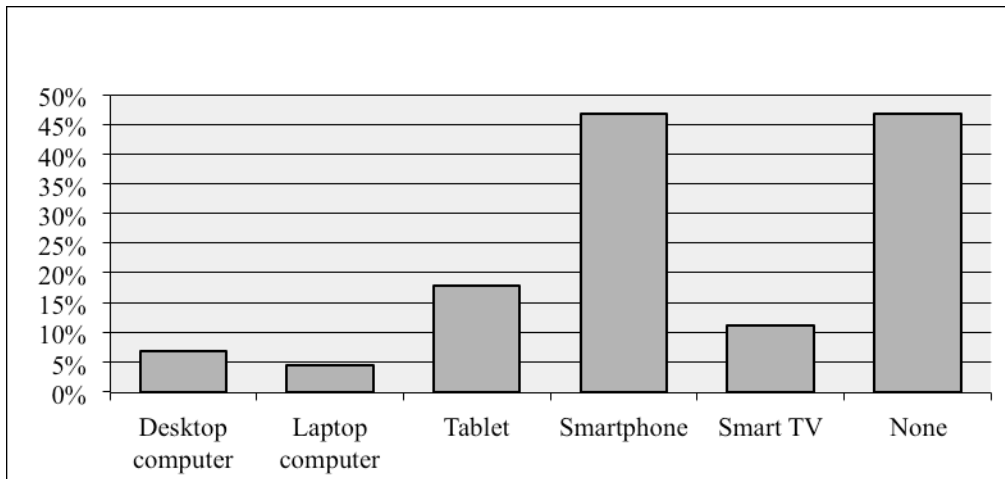


Figure 9. Percentage of the sample regularly using various forms of technology (N=45)

The questionnaire also asked participants to indicate which of a number of listed forms of personal technology they use regularly, and the distribution of responses is shown in Figure 9.

The chart reveals very low levels of usage of personal technology among this sample of older adults: smart phones were the only form of personal technology in use by more than a small minority of respondents, and nearly half of the sample (47%, N=21) reported using no personal technology at all. Eighteen per cent of the sample (N=8) reported using a tablet; 11% (N=5) a Smart TV. Just 7% (N=3) reported using a desktop computer and only 4% (N=2) a laptop computer.

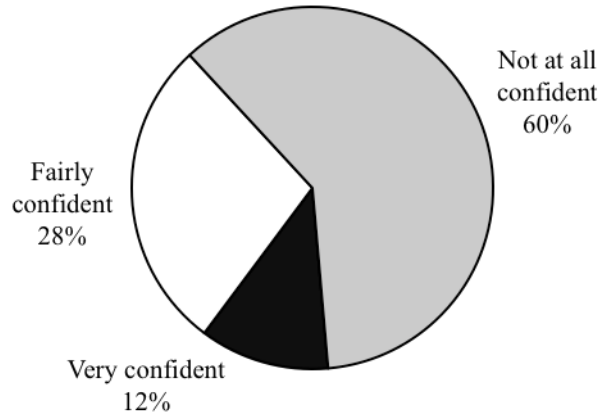


Figure 10. Self-reported level of confidence in using computers and the Internet (N=43)

Respondents were also asked about their level of confidence in their own ability to use computers and the Internet, and the distribution of responses is shown in Figure 10.

The findings show that most of the senior citizens in this sample do not feel confident in their own ability to use computers and the Internet: of the 43 answering this question, 60% (N=26) gave this response, and only 12% (N=5) indicated that they were “very confident” in their own abilities to use computers and the Internet.

Overall, the results presented in this sub-section reveal that, based on the views and experiences of this sample, many senior citizens in Saudi Arabia have relatively low levels of usage of personal technology, little interest in learning about new technologies, and low levels of confidence in their abilities to use technology. However, a minority is more confident in the use of computers and the Internet and has a keen interest in learning about the latest technologies. This appears to be associated, in broad terms, with higher levels of education. The general low levels of interest in and usage of new technologies among this population may present a barrier to the increased adoption of smart phone use, a point that will be addressed further in the Discussion and Conclusion chapter. The following section

presents the detailed research findings relating to the use of smart phones by this sample of senior citizens in Saudi Arabia.

Smart Phone Usage

Extent of Smart Phone Ownership

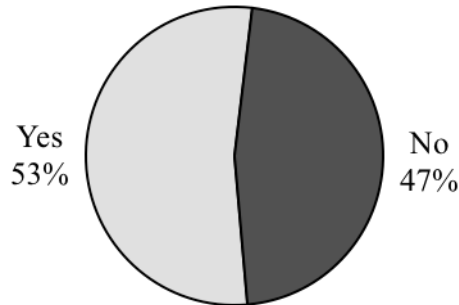


Figure 11. Distribution of sample by ownership/use of a smart phone (N=45)

More than half of all the survey participants (53%, N=24) indicated that they currently own or use a smart phone (Figure 11), a figure that is higher than the corresponding statistic of 30% reported for people aged over 65 in the United States (Anderson, 2015). This suggests that despite the overall low levels of technology usage and the lack of interest in new technologies among the research participants, the overall extent of smart phone ownership is fairly high for people within this older age group in Saudi Arabia. When the smart phone users were asked which brand/model of phone they use, only two brands were mentioned: The Apple iPhone, cited by 58% of those who own or use a smart phone, and Samsung, cited by the remaining 42%.

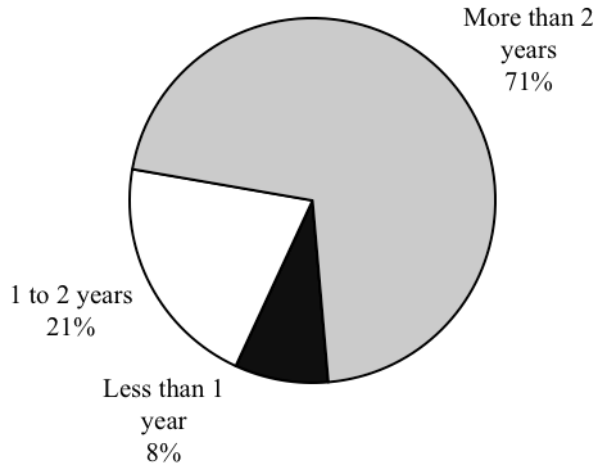


Figure 12. Distribution of users by overall duration of smart phone usage (N=24)

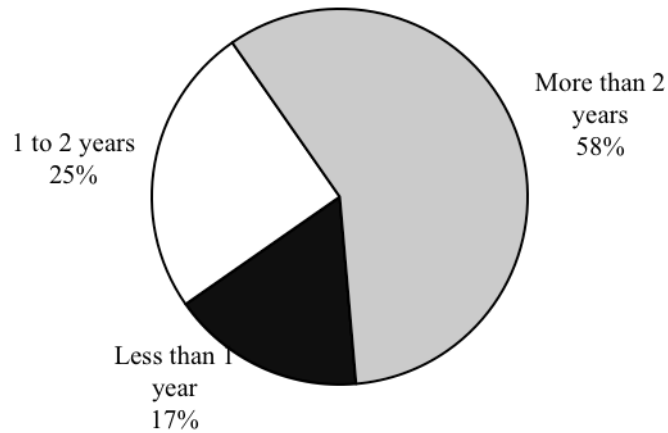


Figure 13. Distribution of users by duration of ownership of current smart phone (N=24)

Among the 24 participants who currently own or use a smart phone, it was found that 71% (N=17) have used a smart phone for more than 2 years (Figure 12) and 58% (N=14) have had their current smart phone for more than two years (Figure 13). This perhaps suggests that, once senior citizens have started using a smart phone they are likely to continue doing so, but also that most smart phone users within this group tend to keep their existing phone for a relatively long time.

Perceived Importance and Use of Smart Phone Features

Studies carried out in other countries have revealed that seniors tend to use a limited range of functions on their phones, either because of their perceived complexity, or because they do not see the benefits of doing so. This study therefore examined the participants' views on and usage of various smart phone features to find out whether this is also the case among senior citizens in Saudi Arabia. This section presents the findings relating to current smart phone users; the questionnaire also asked those participants who do not currently use smart phones for their views on smart phone features and the findings are presented later in the chapter.

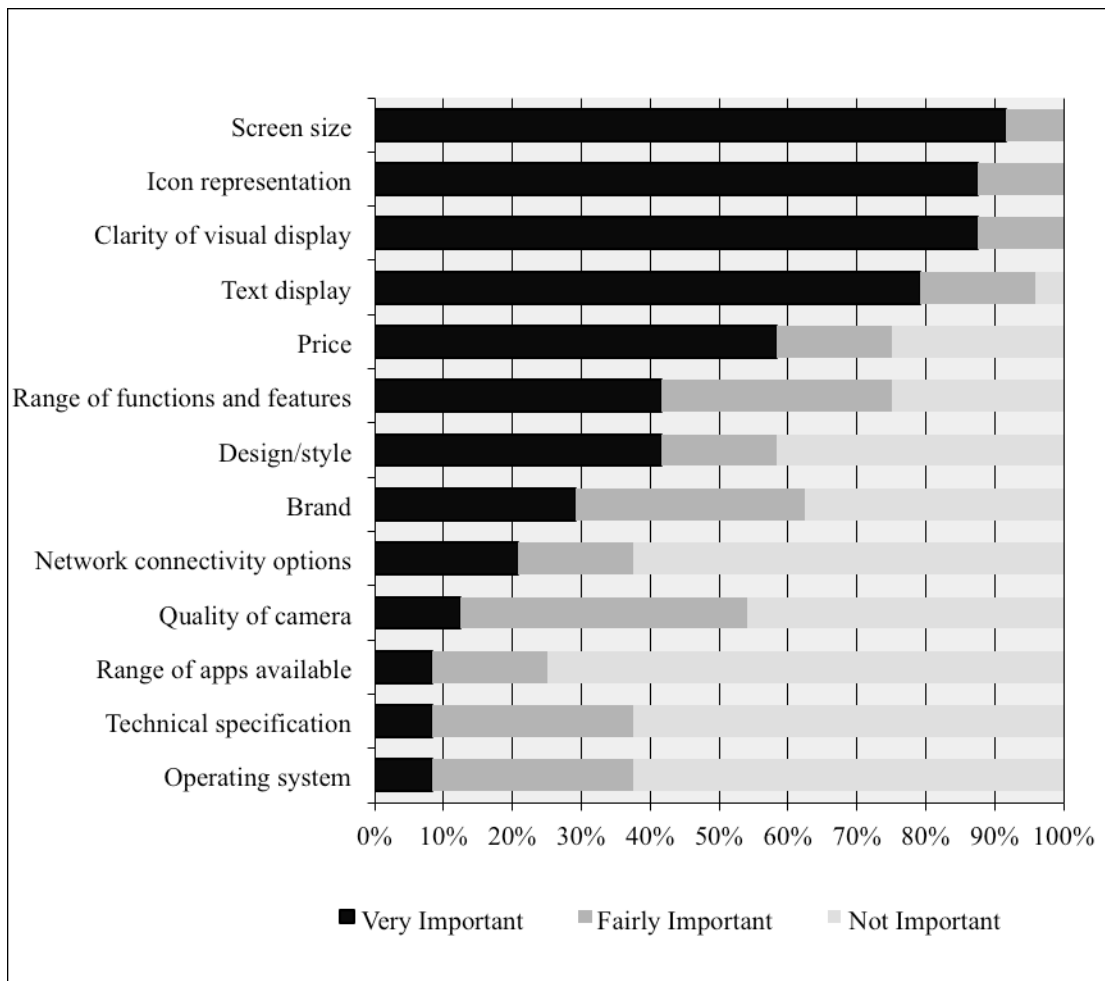


Figure 14. Perceived level of importance of smart phone features among users (N=24)

First, the smart phone users were asked to rate the perceived importance to them (“very important” “fairly important” or “not important”) of a number of listed factors, when purchasing a smart phone. The distribution of results is shown in Figure 14 with the items ordered by the percentages of respondents rating each item as “very important” in their choice of a smart phone. This reveals that the top four priorities for this sample of senior citizens, when purchasing a smart phone, all relate to the visual features of the phone. The most important item was “screen size”, with 92% (N=22) of all current smart phone users saying that this is a “very important” consideration when buying a smart phone. This was closely followed by “icon representation” and “visual display”, with 88% of smart phone users (N=21) ranking each of these as “very important” in their purchasing decision, and “text display”, rated as “very important” by 79% (N=19) of smart phone users in the sample.

These display-related features were followed in importance by price, with 58% of users (N=14) indicating that this is a “very important” consideration for them when purchasing a phone, and by “design/style” and “brand”, which 42% and 29% respectively indicated were “very important” considerations in their purchasing decision. Relatively small numbers of smart phone users ranked the other listed items as “very important”, indicating that features such as camera quality and the range of available applications are not significant considerations for Saudi Arabian senior citizens when buying a smart phone.

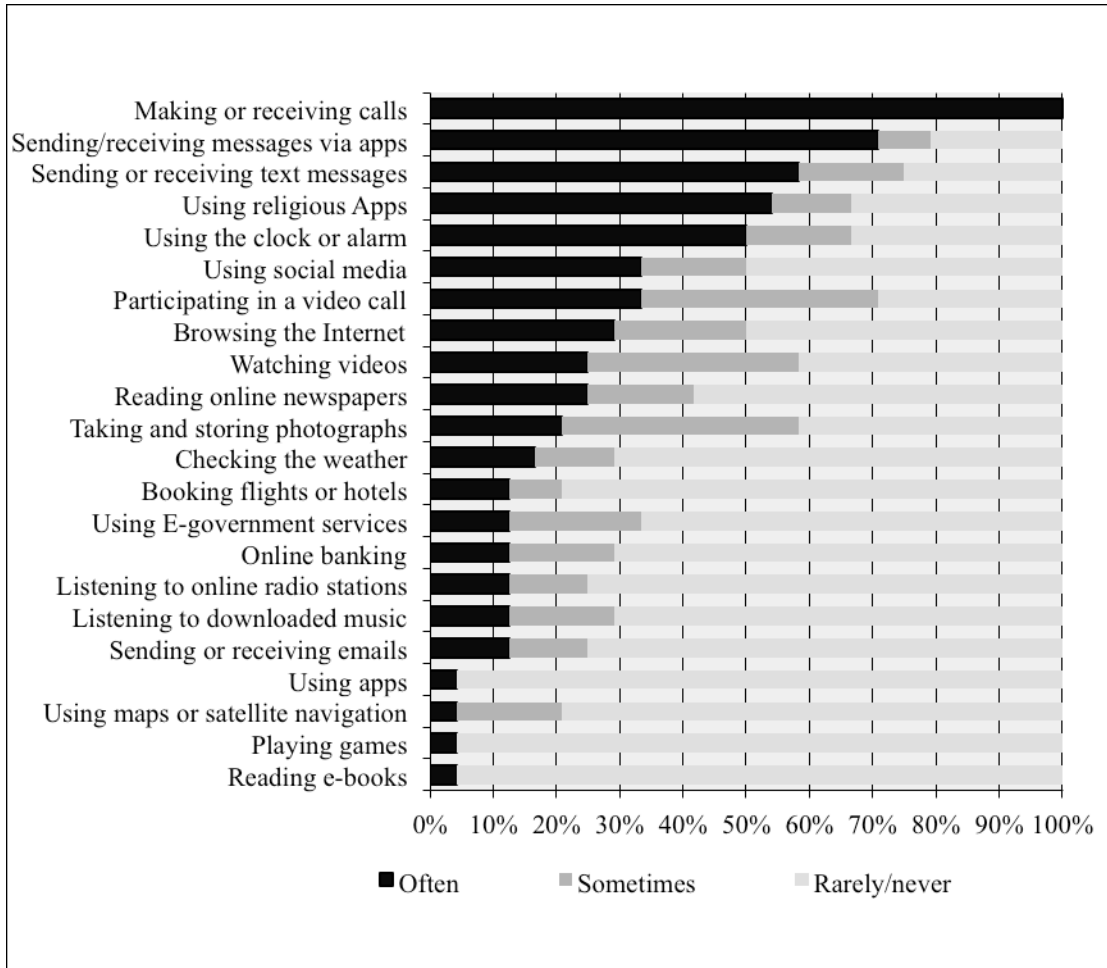


Figure 15. Frequency of use of smart phone features among smart phone users (N=24)

To provide a more detailed understanding of the ways in which senior citizens in Saudi Arabia use smart phones, the research participants who currently own a smart phone (N=24) were also asked to indicate how frequently (“often”, “sometimes” or “rarely/never”) they use each of a list of specified smart phone features. The results are shown in Figure 15.

The data presented in Figure 15 show that the most commonly used smart phone feature among this sample of senior citizens is making/receiving calls, with all (100%, N=24) of the smart phone users indicating that they often use this feature, followed by the use of

messaging applications such as WhatsApp or Facebook Messenger (71%, N=17) and sending or receiving text messages (58%, N=14).

Where the findings are likely to differ from those of studies of smart phone use conducted in Western countries is in the extent of use of “religious applications”, with more than half of all smart phone users in the sample (54%, N=13) indicating that they use this feature of their phone often. This was closely followed in extent of use by the clock or alarm on the phone, used “often” by 50% (N=12) of all smart phone users in the sample. A number of additional features were reported to be used “often” or “sometimes” by at least half of the sample of smart phone users in each case: video-call features such as Skype, used by 71% of smart phone users at least sometimes; social media applications (such as Facebook or Twitter), with a total of 50% using this feature at least sometimes; browsing or searching for Information via the Internet (50% doing so at least sometimes) and taking and storing photos (49% using this feature at least sometimes). These findings indicate that all of these features should be given a high priority when designing a mobile phone interface for senior citizens in Saudi Arabia. In contrast, the other listed features are of lower importance, especially the use of applications (except those mentioned above); maps and satellite navigation systems; games and e-book reading facilities, with each of these used by only one participant in this study.

The research participants were invited to suggest additional features or functions that are missing from their smart phone at present but which they would ideally like it to include. Only six individuals contributed a total of 9 separate suggestions, which have been categorized as follows using thematic analysis methods:

- Improving ease of use: easier settings, larger keyboard, clearer font, reduced number of buttons (5 comments)
- Language and voice related: Voice interaction, converting Arabic speech into written text, ensuring that Arabic language in applications is developed by native speaker and not directly translated (4 comments)

Ease of Use

Perceived Ease of Use

There is significant evidence from other studies that seniors face difficulties in the use of smart phones due to factors including physical and cognitive aspects of the ageing process and a lack of familiarity with technology. This is an important issue since ease of use and perceived ease of use are variables known to have an impact on an individual's likelihood of adopting particular forms of technology.

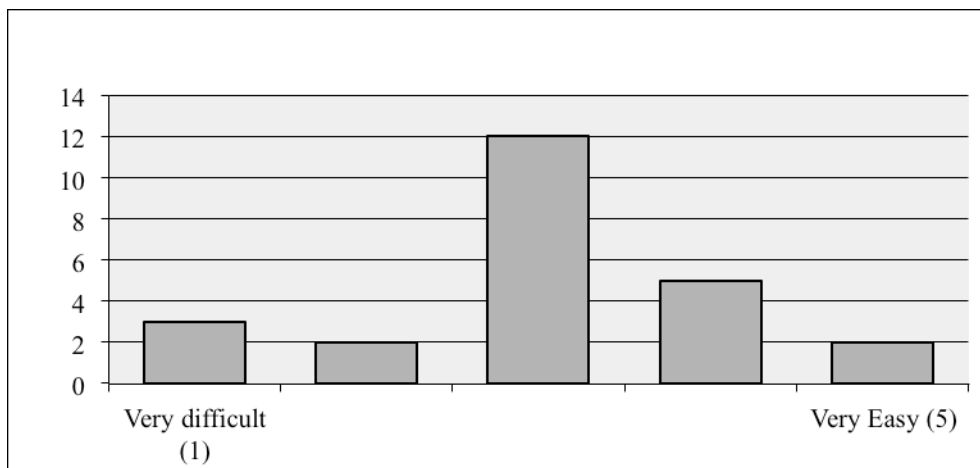


Figure 16. Perceived ease of smart phone use (N=24)

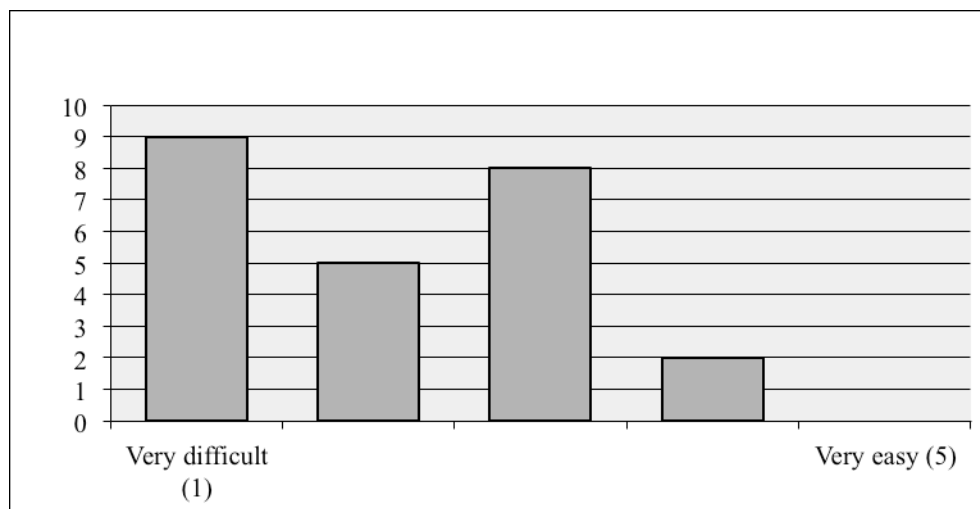


Figure 17. Perceived ease of setting up smart phone account (N=24)

The participants who are current smart phone users in this study were therefore asked two general questions relating to ease of smart phone use and ease of setting up their smart phone account, and the findings are shown in Figures 16 and 17. They were first asked to rate the ease of use of their smart phone, on a scale in which 1 means “very difficult” and 5 means “very easy”. The distribution of responses shown in Figure 15 indicates that, on the whole, this sample of senior citizens do not find it very difficult to use smart phones but on the other hand most do not find this very easy. The average (mean) score was 3.04.

The distribution of response to the question “how easy was it to set up your smartphone account?” is shown in Figure 17, based on the same scale in which 1 corresponds with “very difficult” and 5 with “very easy”. This distribution is different to that shown in Figure 16, and indicates that on the whole, the sample of senior citizens in this study had greater difficulty with initially setting up their smart phone account than with subsequently using their smart phone. Thirty-eight percent (N=9) of the smart phone users in the sample reported that they had found it “very difficult” to set up their smart phone account, while

none reported finding it “very easy”. The average (mean) score was 2.3, which indicates that most participants experienced difficulty in setting up their account. This suggests that, in order to encourage more senior citizens in Saudi Arabia to use smart phones, measures may be necessary to facilitate the process of setting up a smartphone account, an issue that will be addressed further in the final chapter of this dissertation.

Difficulties in Using Smart Phone Features

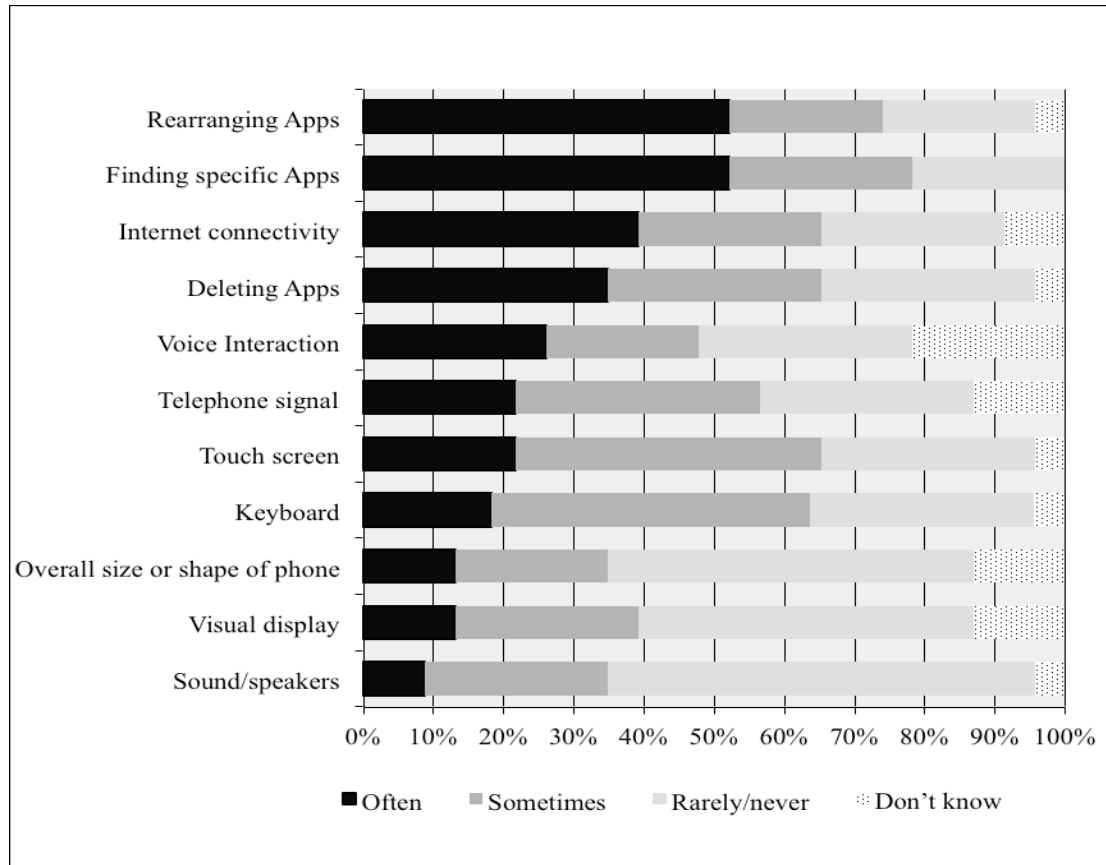


Figure 18. Frequency of difficulty when using smart phone features (N=24)

The participants who currently use smart phones were also asked how often they experience difficulties when using any of a list of specified features of their phone. The findings are shown in Figure 18, with the features ordered by the percentage of respondents

reporting that they “often” experience difficulties when using this feature. Overall, this chart reveals that many of the participants in this study who currently use smart phones experience difficulties with their features. Of the 11 items listed, at least 50% of participants reported that they experience difficulties at least sometimes with all but four of these.

Difficulties were experienced most frequently with the applications-related features of phones: around half of the users reported that they “often” experience difficulties with “finding specific applications” and “rearranging applications”, and 78% (N=18) and 74% (N=17) respectively indicated that they face these difficulties at least sometimes. “Deleting applications” was also reported to be a frequent source of difficulty, encountered “often” or “sometimes” by a total of 65% (15) of the smart phone users. More than fifty percent of participants in each case also reported that they at least sometimes experience difficulties when using their phone’s touchscreen (65% in total) and keyboard (63% in total).

Other features causing difficulties for smart phone users in this sample were found to be Internet connectivity and telephone signal problems, which based on respondents’ additional comments may reflect the slow speed of the Internet in Saudi Arabia and problems with mobile phone signal coverage rather than an issue with smart phones themselves. Interestingly, despite the reported emphasis on display features in smart phone purchasing decisions, as reported earlier in the chapter, a lower but still substantial percentage of smart phone users indicated that they experience difficulties at least sometimes with the visual display features of their phone (39% in total). The fact that this feature appears to cause difficulties less frequently than some of the other aspects of smart phone use may reflect the emphasis given by respondents to a suitable visual display when purchasing their smart phone. Thirty-five percent in total reported that they experience difficulties at least

sometimes with the sound-speakers on their phone, again a lower rate of difficulties than for other features listed.

The respondents were also asked to specify the types of difficulties they experience with their phone in a textual field of the questionnaire. Sixteen participants provided a total of 28 comments (many submitted multiple comments). Using thematic analysis to identify commonalities between these comments, they have been categorized as follows:

- Visual display issues: screen or text too small; screen too bright, or not bright enough in the sun; icons too small or not clearly distinguishable from buttons (7 comments)
- Navigation problems: Difficulties in locating or installing applications or finding features such as contacts (5 comments)
- Lack of understanding or confidence of user: rely on children to help with Internet connectivity and using applications; don't know what the different applications are; don't like to ask for help when using phone (5 comments)
- Touchscreen or keyboard related issues: Keyboard or keys too small; touchscreen not responsive enough (5 comments)
- Connectivity problems: Slow Internet (3 comments)
- Other: problems with specific applications; don't need many features of phone; use of smart phone is isolating (3 comments)

Physical and cognitive impacts on smart phone use

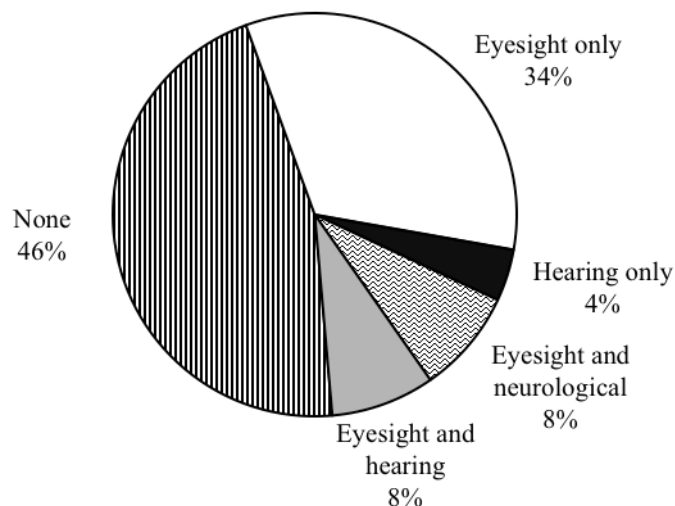


Figure 19. Impact of health factors on smart phone use (N=24)

There is evidence from other studies that the problems senior citizens experience when using smart phones are often due to physical, cognitive and psychological factors relating to the ageing process. Therefore, this study asked participants to specify whether they have any health-related problems that affect their ability to use smart phone functions, and if so, whether these are related to eyesight, hearing, neurological factors or other health-related factors. Participants could record more than one health issue, and the overall distribution of responses is shown in Figure 19.

The findings revealed that almost half (46%, N=11) of this sample of senior citizen users of smart phones in Saudi Arabia do not perceive that they experience any health-related problems that affect their use of their smart phone. Problems reported by the remainder of participants were mostly eyesight related: 34% (N=8). Small numbers of participants reported having hearing a combination of eyesight and hearing problems or eyesight and

neurological problems (8%, N=2 respectively), while just one reported having hearing problems that affected smart phone use.

Non-Users of Smart Phones

In order to understand what is needed to improve the uptake of smart phones among senior citizens in Saudi Arabia, it is also important to explore the views of individuals in this group who are not smart phone users, and to identify the main reasons why they do not currently use smart phones.

Within the sample of participants in the current study, 47% (N=21) reported that they do not currently own or use a smart phone. Of these, 90% (19) reported that they regularly use another type of mobile phone.

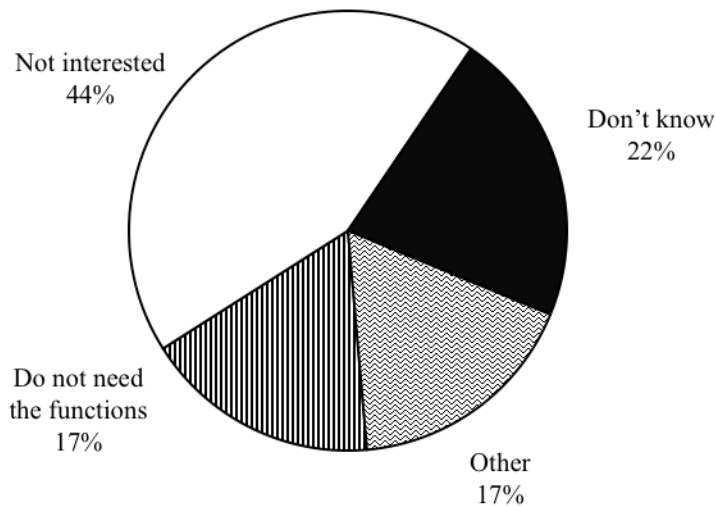


Figure 20. Reasons for not using a smart phone (N=21)

When asked to indicate which of a number of listed factors were reasons why they do not use a smart phone, 48% (10) said they were not interested in having a smart phone, 19% (4) said they did not need the functions of a smart phone and 24% did not know or gave another response such as not knowing how to use a smart phone or perceiving that it would be difficult to use (Figure 20). None of these participants said that cost was a reason for not having a smart phone.

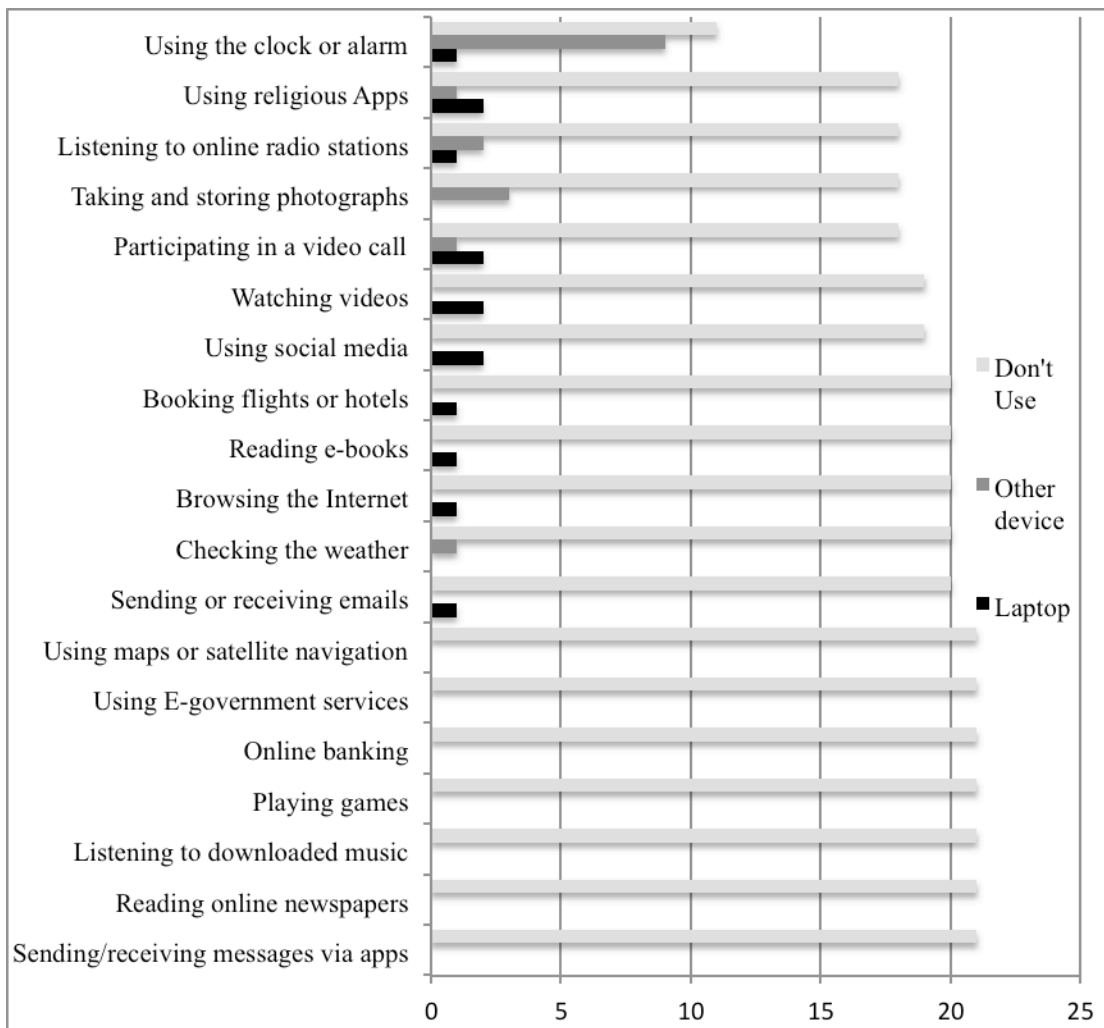


Figure 21. Use of other devices by non-users of smart phones (N=21)

To explore further the potential for the increased uptake of smart phones among current non-users and the types of features that these might include, the non smart phone users in the sample were asked to indicate which of a list of items they currently use and which device they most often use them on: a PC, laptop or another device. Most of the items corresponded with the features that the smart phones users were asked about. The distribution of responses is shown in Figure 21.

Very few of the non users of smart phones in this sample reported using other devices to carry out the types of tasks for which smart phones are often used. For each of the nineteen items listed, the majority of participants indicated that they do not carry out this activity at all. None of them reported using a desktop PC to carry out any of these tasks. Apart from the clock/alarm function, which 10 participants reported using on “another device”, a very small number of no more than 3 participants in each case reported using either a laptop or another device to carry out each of the tasks listed. These findings indicate that the sample participants who are currently not smart phone users have not recognized a need for many of the features provided by smart phones, and their lack of use of a smart phone is not because they are accessing these features on other devices. This has implications for raising awareness among senior citizens in Saudi Arabia of the potential benefits of smart phone features that will be discussed in the final chapter of the dissertation.

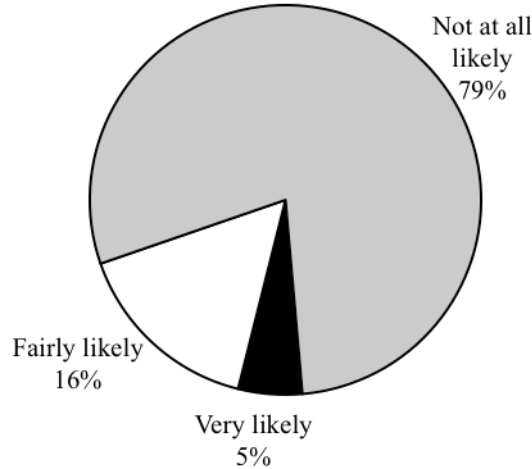


Figure 22. Likelihood of buying a smart phone in future, non users (N=21)

The research results indicate that at present the majority of non-users of smart phones have no intention to purchase a smart phone in future. They were asked, “If you were buying a new phone in future, how likely do you think you would be to choose a smart phone?” and the distribution of responses is shown in Figure 22. Seventy-nine percent of this group of participants (N=15) said that they were “not at all likely” to purchase a smart phone in future, and only one participant indicated that they were “very likely” to do so, with the remainder (N=3) saying they were “fairly likely” to buy a smart phone.

To investigate further the potential future demand for smart phone features among current non-users of smart phones, the questionnaire also asked this group to imagine that they had been bought a smart phone as a gift, and to indicate which of a list of features they would be likely to use. The results could then be compared with the actual usage statistics of current smart phone users. The distribution of results for current non-users of smart phones is shown in Figure 23, ordered by the percentages of respondents indicating that they would be “very likely” to use that smart phone function.

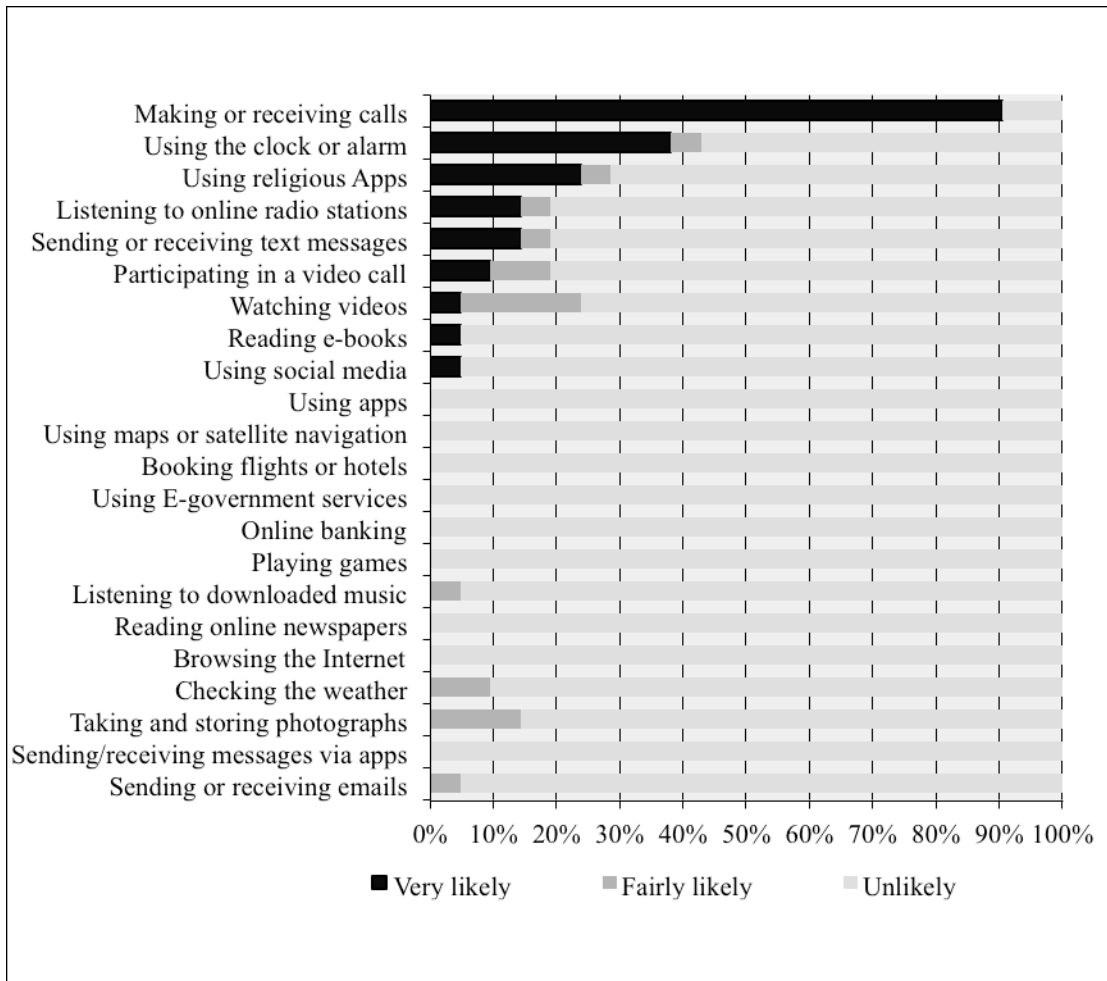


Figure 23. Likelihood of using specific features if given a smart phone (N=21)

The only listed smart phone function which a majority (90%, N=19) of these participants said they would be “very likely” to use was “making or receiving calls”, followed by “using the clock or alarm” which 38% (N=8) said they would be “very likely to use”. However, these are functions of other types of cell phones and the findings therefore indicate that these participants have no perceived need for the functions of a smart phone over and above other types of phone. Smaller percentages of participants in each case indicated that they would be either “very likely” or “fairly likely” to use other functions such as using religious applications (29%, N=6), listening to online radio stations (19%, N=4), sending or receiving text messages (19%, N=4), participating in a video call (20%, N=4) and

watching videos (24%, N=5). These small but significant levels of interest indicate that there may be potential for expanding interest and awareness in the benefits of these features among other senior citizens in Saudi Arabia, a point that will be explored further in the Discussion chapter. However, there was very little or no interest among these participants in any of the other smart phone features listed.

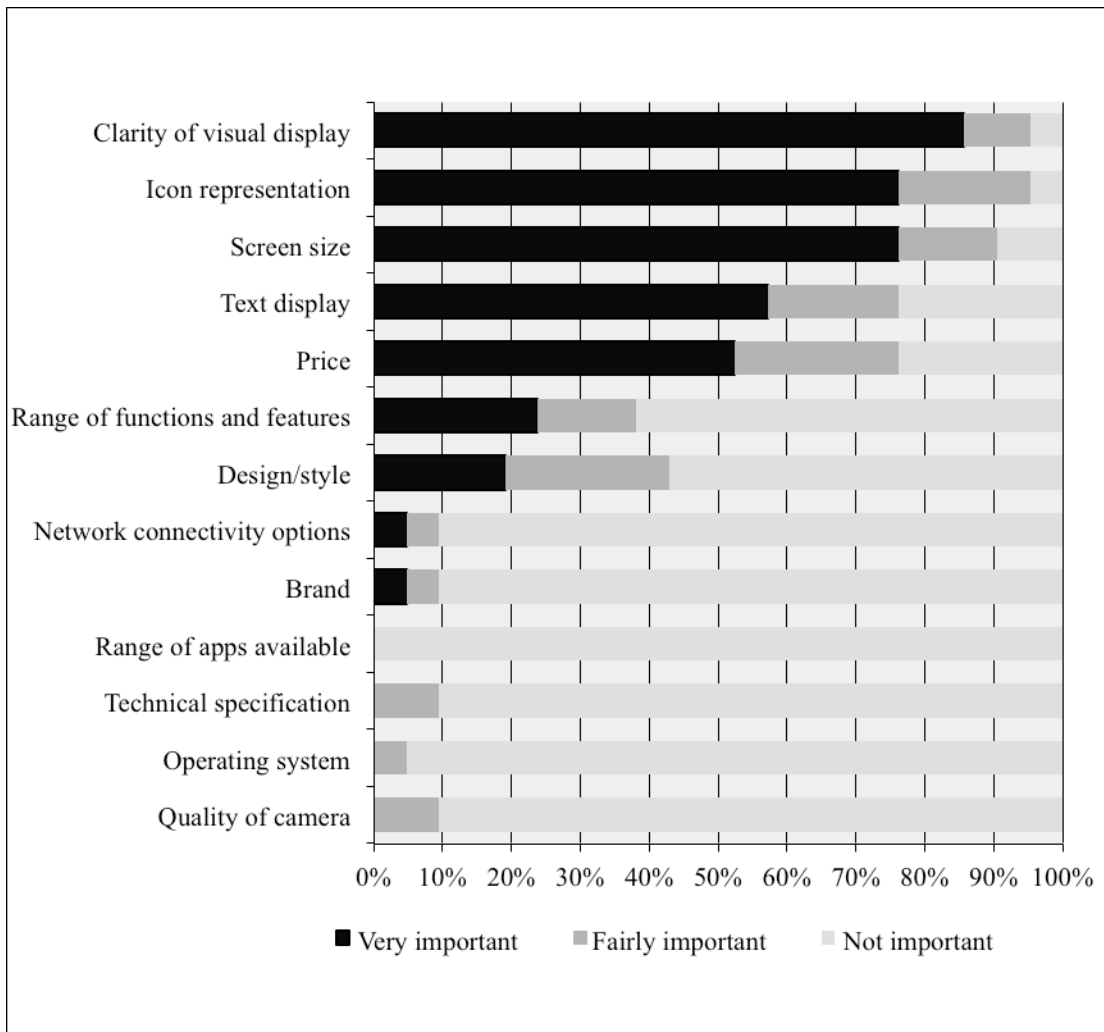


Figure 24. Likelihood of using specific features if given a smart phone (N=21)

Finally, the non-users of smart phones in the sample were asked to imagine that they were buying a smart phone in future, and to indicate how important (“very important”, “fairly important”, “not important”) a number of listed features would be in their decision about which model to buy. The distribution of responses is shown in Figure 24, with the items ordered by the percentages of respondents rating each item as “very important” in their hypothetical selection of a smart phone.

In this case, the distribution of responses of current non-users of smart phones is very similar to those of current users, as shown earlier in Figure 14. Although the specific ordering of items ranked as “very important” by the majority of participants varied slightly between the two groups, both gave priority to the visual display aspects. In the case of the current non users of smart phones, “clarity of visual display” was ranked highest, with 86% (N=18) saying that this would be very important in their choice of phone, followed closely by icon representation (76%, N=16), screen size (76%, N=16), and text display (57%, N=12). As in the case of current smart phone users, price was given the next highest priority as a consideration when buying a smart phone, with 52% (N=11) indicating that this factor would be “very important” in their choice. Also similar to the current users, the non-users did not place a high priority on factors including the range of applications available, the operating system, technical specification or quality of camera. In the case of this group, the numbers allocating any level of importance to these factors was even lower than for the current smart phone user group.

Overall, these findings relating to the characteristics and attitudes of current non-users of smart phones indicate little evidence of potential future demand for smart phone use among this group. However, this may relate to a lack of awareness or understanding of the

potential benefits of smart phones for older people or concerns about the complexity of smart phones and their features, which is explored further in the final chapter of this dissertation.

Chapter Summary

This chapter has described the findings relating to the first three research questions of this study, based on the results of a semi-structured questionnaire survey with a sample of 45 senior citizens in Saudi Arabia, including both users and non-users of smart phones. Analysis of the survey results indicates that there are relatively high levels of smart phone usage among this group, compared with people of the same age range in other countries, and compared with the use by the sample participants of other forms of new technology. In line with previous studies conducted in other countries, this study found evidence that senior citizens experience difficulties in the use of smart phones, and would like modifications in their design to improve ease of use, particularly in relation to visual features. Some findings were more unique to this environment, such as the relatively frequent use of religious applications, and the suggestions of some participants for text and voice features in the Arabic language that are designed by native speakers. Among the participants who are not currently smart phone users there was little evidence from the research findings of likely future demand for smart phones, though this may reflect low levels of awareness of their potential benefits for older people.

CHAPTER 5.

PROTOTYPE APPLICATION EVALUATION RESULTS

This chapter presents the results of a user trial of a prototype religious smart phone application interface, which was designed to meet the needs of senior citizens in Saudi Arabia. Preliminary survey research with a sample of senior citizens in this setting revealed that, among this group, the three most important functions of a mobile phone are making and receiving calls, the alarm and religious applications (see Chapter 4). Regular cell phones provide the first two of these features but not usually the third, which is a requirement more specific to Muslim users of smart phones. The preliminary research also revealed that, like senior citizen users in other settings, older people in Saudi Arabia particularly emphasize the importance of visual display when using smart phones.

Taking these findings into account, a prototype religious application was designed with an interface intended for use by senior citizens in Saudi Arabia. A user study was then designed and conducted with a sub-group of the original research sample and additional participants to evaluate the effectiveness of the prototype application. The distribution of the sample of 41 seniors by age, gender and marital status is shown in Table 1.

The research participants were asked to independently explore the prototype application and its features and were then interviewed regarding their views on the application and experiences of using it. The evaluation results are presented in this chapter and are used to develop a set of best-practice design recommendations for smart phone applications intended for senior citizens in predominantly Muslim, Arabic speaking countries, which are presented in Chapter 7. The following sections describe the application and include visual examples of the screens and content incorporated in it.

Table 1
Distribution of Prototype Evaluation Sample by Age, Gender and Marital Status

No.	Age	Gender	Marital Status
1	67	F	Married
2	66	F	Divorced
3	67	M	Married
4	73	F	Widowed
5	65	M	Married
6	71	M	Widowed
7	70	F	Married
8	68	M	Widowed
9	71	F	Married
10	66	F	Married
11	69	F	Divorced
12	69	M	Married
13	77	M	Married
14	66	F	Widowed
15	72	M	Married
16	65	F	Married
17	72	M	Married
18	75	M	Widowed
19	74	F	Divorced
20	67	F	Married
21	68	F	Married
22	73	F	Widowed
23	74	M	Married
24	69	M	Widowed
25	66	F	Married
26	76	M	Married
27	73	F	Widowed
28	77	M	Married
29	67	F	Married
30	69	M	Married
31	65	F	Widowed
32	68	M	Widowed
33	66	M	Married
34	66	F	Married
35	70	M	Married
36	66	M	Married
37	69	F	Married
38	70	F	Widowed
39	73	M	Married
40	68	M	Married
41	72	F	Married

Design of the Prototype Application

The decision to develop a religious prototype app was based on the key findings of the stage 1 survey, which highlighted in particular the perceived importance of a religious application among senior citizens in Saudi Arabia. The content of the application is taken from the app of the Saudi Arabian Ministry of Culture and Information (Manasek).

The application was designed using the JustInMind online prototyping tool for web and mobile apps (<https://www.justinmind.com>). This tool enables users to develop apps for Web, iOS and Android with minimal use of coding, facilitated by the use of pre-existing templates that can be adapted for use. User interaction features can be added and easily tested using the software. This tool provided adequate functionality for the purpose of developing a prototype app for evaluation purposes: the only limitations were slight inflexibilities in the ability to vary the formatting of different objects or to customize the toolbar. The use of JustInMind allowed for the development of a prototype application with fully functional interactivity, though this was only a working prototype and not a fully developed app.

The specific design of the application took into account the best practice guidance for smart phone design for seniors as discussed in the literature in Chapter 2. In particular, the best practice principles that were followed in the design of the prototype were as follows:

- 1) A bright screen
- 2) Large font sizes (14 for paragraph/text, 16 for titles)
- 3) Clear contrast such as black buttons with white text inside the buttons, black paragraph/text on white background.
- 4) Easy to read buttons, which are understandable to the target audience (in this case consisting of names of Hajj/pilgrimage days, rulings of pilgrims, sunnahs, types of

- pilgrims, and How to make Ihram, all of which will be known to every Muslim before he/she starts Hajj/ pilgrimage to accomplish the Hajj)
- 5) Avoiding the use of moving graphics, flashing texts
 - 6) Generous spacing between items (e.g. between buttons, between a title and text, between buttons and pictures, and between pictures and text).
 - 7) The use of simple Interfaces - some pages have only buttons with clear titles for the selection by users of Hajj/pilgrimage days, rulings of pilgrims, sunnahs, types of pilgrims, and How to make Ihram for more explanation. Other pages simply contain hajj days with titles, explanations, pictures and one or two buttons.

Structure and Content of the Prototype Application

The overall structure of the prototype application is shown in Figure 25.

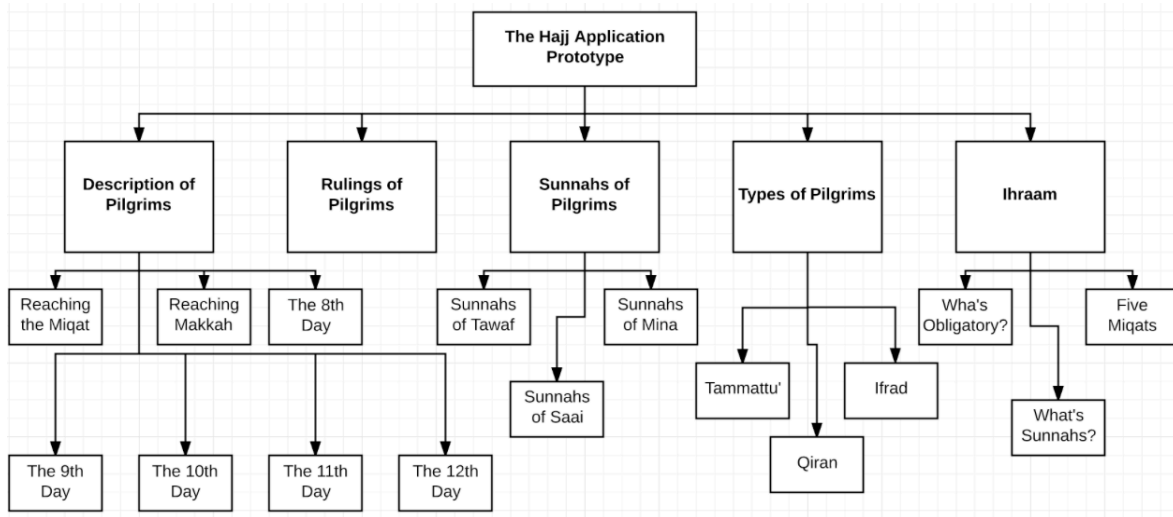


Figure 25: Structure of the Prototype Application



Figure 26: Religious application home screen

Figures 26 to 29 provide examples of the application interface, with each example shown in English and Arabic format. The research participants used the Arabic version of the application for the purpose of evaluation, but an English language version has also been created for the purpose of this thesis.

Figure 26 shows the home screen or the introductory screen for the application. With an attractive visual background with graphics that clearly indicate that this is an Islamic religious application, and five touch screen buttons that link to the main components of the application. Taking into account the need for visual clarity, as identified in the stage 1 survey, 16-font size was used for the home screen buttons. Within screens, 14-font size was used for text, and 18-font size for page titles.

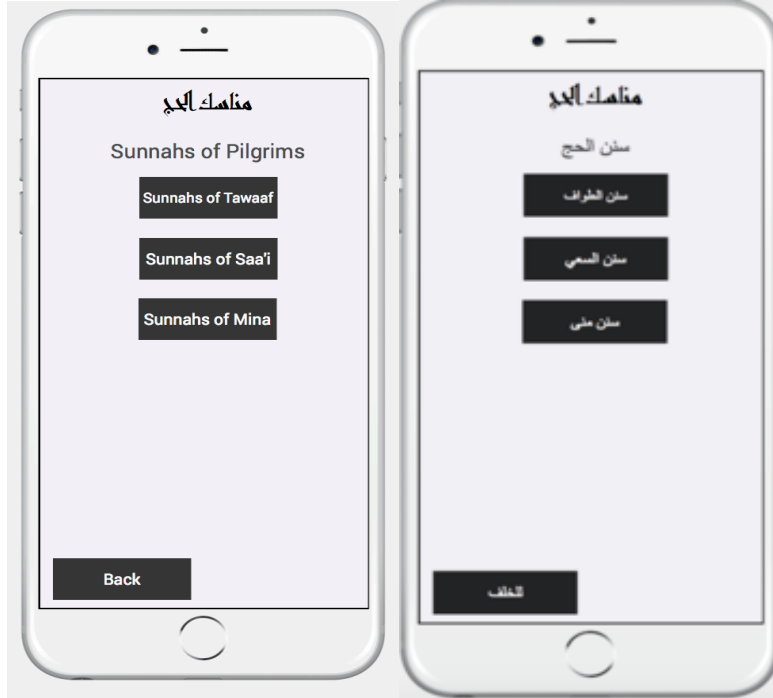


Figure 27: Sunnahs of Pilgrims screen

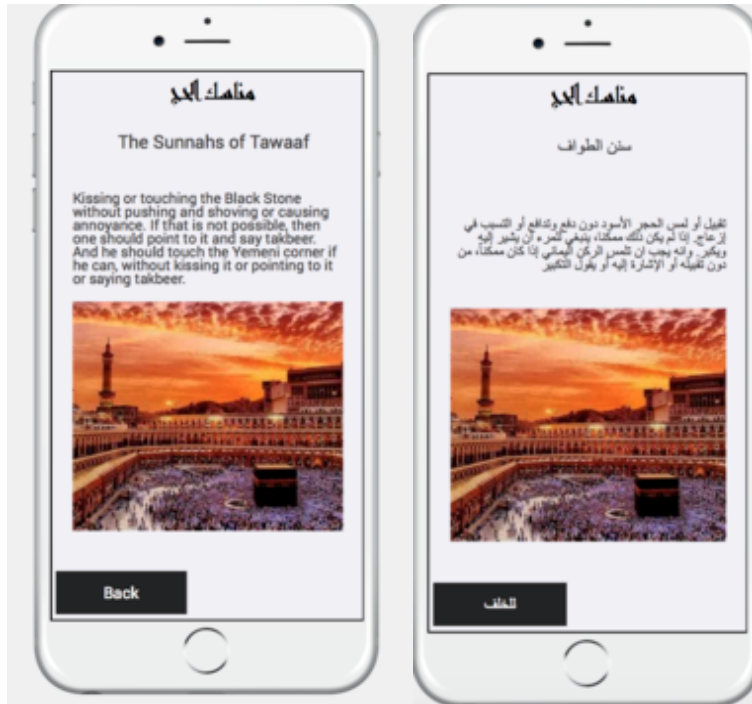


Figure 28: Sunnahs of Tawaaf

Figure 27 shows the screen accessed via the “Sunnahs of Pilgrims” button on the homepage. Sunnahs relate to the teachings of the prophet, which provide guidance to pilgrims when visiting Mecca and other sacred locations in Saudi Arabia. These include, for example, the prayers that must be said in different locations (Sunnahs of Mina), and what must be done in sacred places, such as kissing the black stone (Sunnahs of Tawaaf), as shown in Figure 28.



Figure 29. Guidance on 10th day pilgrimage requirements



Figure 30. Guidance on requirements of pilgrims when reaching the Miqaat



Figure 31. Guidance on requirements of pilgrims when reaching Mecca

Through the “Descriptions of Pilgrims” button on the home screen, users can access detailed information about what to do on each day of their pilgrimage. Figures 29 through 31 show the information provided for the 10th Day (Figure 29); what is required of pilgrims on reaching the Miqaat, such as putting on sacred garments (Figure 30), and on reaching Mecca (Figure 31) and what is required of them on other specified days, in terms of prayer, other actions, clothing etc.

Recruitment and Participants

In order to generate a sample of research participants for the prototype application evaluation, the seniors who participated in the initial questionnaire survey research were first contacted by email or telephone to ask if they would be prepared to participate in the trial. As in the first stage of the study, the investigator's personal friends and other contacts were requested to ask their own relatives aged over 65 if they would be willing to be participate in the study and share their experiences of using the prototype religious application interface. A total of 56 individuals initially agreed to participate in the evaluation. However, initial contact with these individuals revealed that 15 of the volunteers could not read or write. These were excluded from the study leaving an achieved sample of 41 participants, all aged 65 or over. Some participants indicated that they have eyesight problems, but these candidate subjects were not excluded from the study as it was considered important to explore whether seniors experiencing these types of difficulties could use the application.

The participants were asked to independently browse the application for around 15 minutes. They were given no specific instructions but were able to ask the researcher for assistance if necessary in navigating the menus and screens. The researcher then interviewed

them to investigate their views on the application, using a semi-structured questionnaire (see Appendix B). The findings of this evaluation are presented below.

Evaluation Results

Likelihood of using application

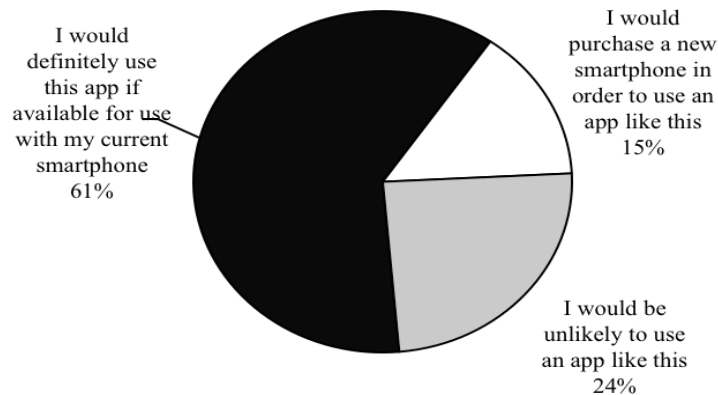


Figure 32. Likelihood of using this type of smartphone application (n=41)

The participants were first asked about the likelihood that they would use this type of smartphone application. They were asked to select from three possible responses, and the distribution of answers is shown in Figure 32. The majority (61%) of participants indicated that they would definitely use this application if available for use with their current smartphone, and a further 15% said that they would be prepared to purchase a new smartphone in order to be able to use an application of this type. However, around a quarter (24%) of all participants indicated that they would be unlikely to use this type of application.

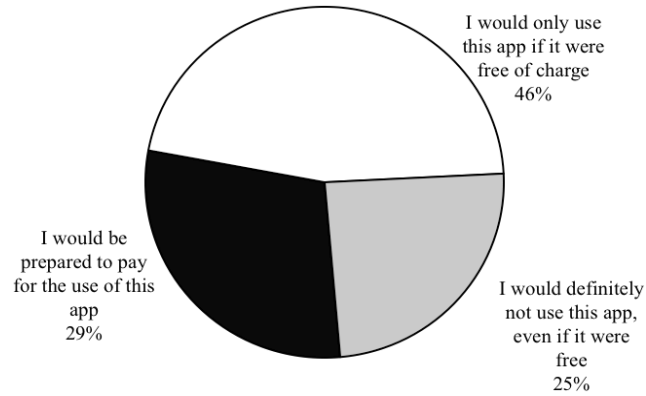


Figure 33: Likelihood of using application depending on cost (n=41)

To explore further the participants' interest in purchasing and using this type of religious smart phone application, they were also asked whether they would be prepared to pay for the application, whether they would only use it if it were free of charge, or if they would definitely not use it even if it were free. Again, around a quarter confirmed that they had no interest in the application and would not use it, even if it were free. Of the remainder, more than a quarter of all respondents (n=12) indicated that they would be prepared to pay for an application of this type and the remaining 46% said they would only use the application if it were free (Figure 33).

Perceived wider popularity of the application

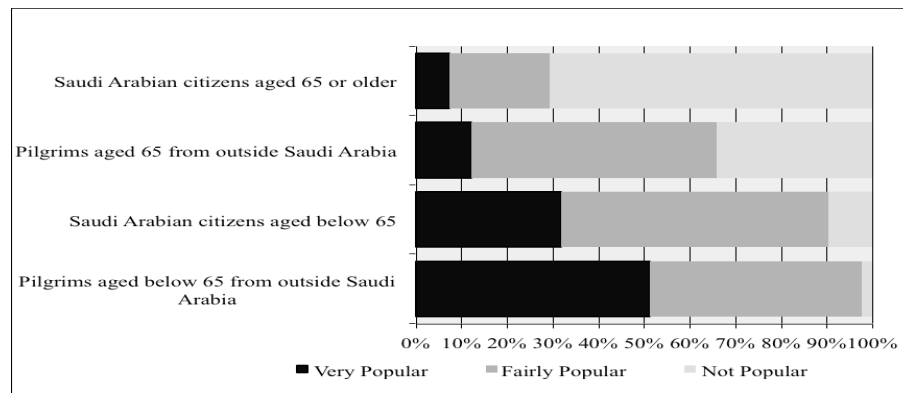


Figure 34: Perceived popularity of application among different groups (n=41)

In order to explore the likely wider potential interest in the application within Saudi Arabia, the participants were also asked to indicate how popular they thought it would be among four separate groups: Saudi Arabian citizens aged below 65, Saudi Arabian senior citizens (aged 65 and above), Islamic pilgrims aged below 65 from outside Saudi Arabia and senior citizen Islamic pilgrims from outside Saudi Arabia. It is important to note that, although an ultimate objective of the study is to develop recommendations for an application targeted at a wider population of seniors in Arabic-speaking Muslim countries, the specific prototype app was designed more specifically for use by older Saudi Arabians and older pilgrims from other countries. For each specified category of user, participants were asked whether they felt the application would be “very popular”, “fairly popular” or “not popular”. The distribution of responses is shown in Figure 34.

Although the application was designed largely with Saudi Arabian senior citizen users in mind, the results show that the research participants perceive that this is the group among which the application is least likely to be popular. Only 7% of the participants (N=3) expressed the view that the application would be “very popular” with Saudi Arabian senior citizens, and a further 22% (n=9) thought that it would be “fairly popular” with this group. The majority of 70% (n=29) expressed the view that the application would not be popular with Saudi Arabian senior citizens. In the case of senior citizen pilgrims from outside Saudi Arabia, slightly higher numbers of participants expressed the view that the application would be “very popular” (12%, n=5) or “fairly popular” (53%, n=22) with this group, while 34% (n=14) thought the application would not be popular with senior citizen pilgrims from outside Saudi Arabia.

In contrast, the vast majority of the research participants indicated that they thought this religious application would be popular with younger people aged below 65, within the Saudi Arabian population and especially younger pilgrims from other countries. Thirty-one percent (n=13) thought the application would be “very popular” among Saudi Arabians aged below 65, and 51% (n=21) thought it would be “very popular” among foreign pilgrims aged below 65. Most of the remaining participants expressed the view that the application would be “fairly popular” among both of these younger age groups: only 10% (n=4) felt it would not be popular among younger Saudi Arabians and only 1 participant felt the application would not be popular among foreign pilgrims aged below 65.

It is perhaps unsurprising that large percentages of respondents indicated the view that the application would be popular among Saudi Arabians and pilgrims aged below 65, since the content is not exclusively aimed at senior citizens. Further, since the content is focused on the requirements of pilgrims to Saudi Arabia, it is not completely unexpected that high percentages of participants expect the application to appeal more to Saudi Arabian pilgrims from other countries than to Saudi Arabian senior citizens. Nonetheless, these findings suggest that a religious application of this kind may need to be more tailored to the specific information and functional requirements of Saudi Arabian senior citizens in order to meet the demand for a religious application expressed in the survey results.

Views on Design and Functionality of the Application

Participants were then asked for their views on various aspects of the design and functionality of the application. First, they were asked to rank the perceived ease or difficulty of use of four features: text content; using menu buttons/touchscreen, navigating between screens and finding relevant information. The distribution of responses is shown in Figure

35, with the items ordered by the total percentage of participants indicating that they felt this feature was “very easy” to use.

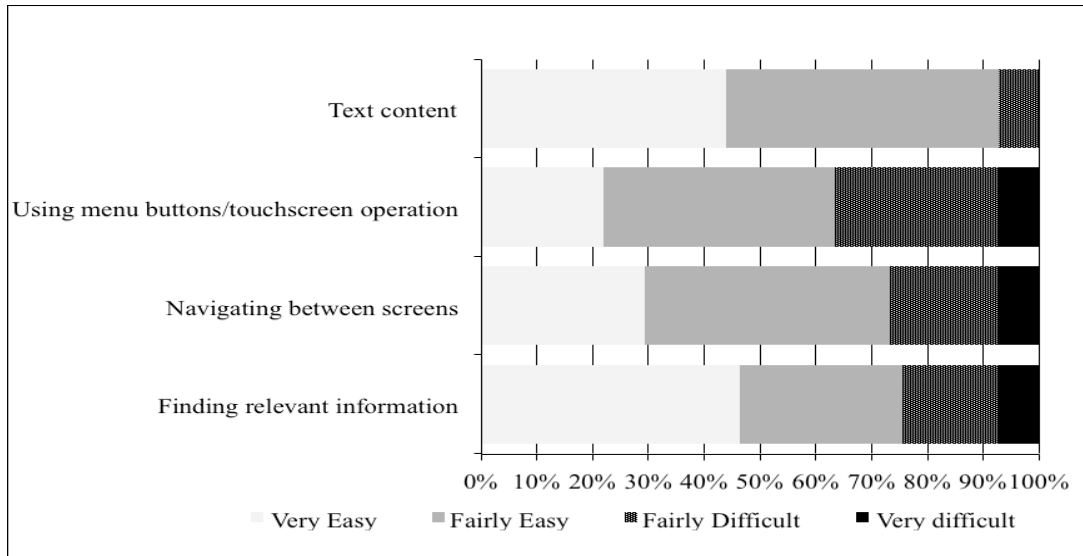


Figure 35: Perceived ease of use of application functions (n=41)

Figure 35 shows that the majority of participants felt that each of the listed functions were either “very easy” or “fairly easy” to use. Overall perceived ease of use was highest for “text content”, with a total of 92% (38 participants) indicating that they felt the text content of the application was “very easy” or “fairly easy” to use, and none indicating that the text content was “very difficult” to use. Higher percentages, however, expressed the view that the other listed features were either “fairly difficult” or “very difficult” to use. Although only three participants in each case indicated that they felt these functions were “very difficult” to use, when combined with the “fairly difficult” responses, the overall percentages experiencing at least some difficulty were 36% (n=15) in the case of the menu buttons/touchscreen operation; 26% (n=11) in the case of navigation between screens, and 24% (n=10) in the case of “finding relevant information”. These results support the findings of earlier studies, which found that senior citizens often experience difficulties when using

smart phones. Even though the application was designed to be user friendly in relation to this age group, they confirm that many older smart phone users experience difficulties in using the features and functions of smart phones. If they are not to be deterred from using these types of phones, even more attention needs to be paid to identifying ways in which applications can be made more straightforward and intuitive for older users.

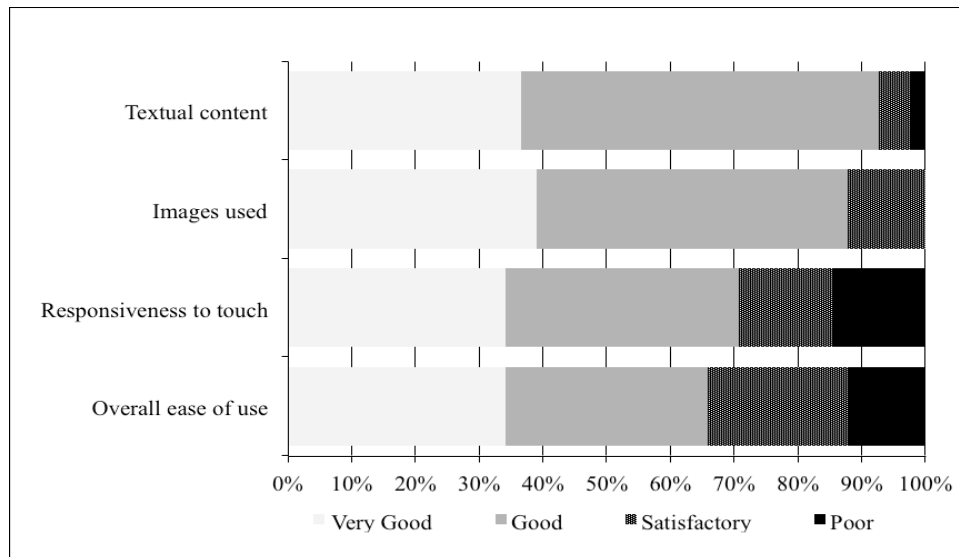


Figure 36: Views on application functions (n=41)

The participants were also asked for their general views on the following features of the application: textual content, images used, responsiveness to touch and overall ease of use.

The distribution of responses (Figure 36) largely reflected those given to the previous question. Overall, the participants were very positive about the textual context of the application and the images used. In total, 92% expressed the view that the textual content used in the application was either “good” or “very good” (n=38), and 87% gave one of these responses when asked about the images used (n=36). Only 1 participant was of the view that the textual content was poor.

However, although the majority of participants also gave positive responses about “responsiveness to touch” and “overall ease of use” respectively (70%, 65%), a higher minority in each case was less positive about these features. Twenty-nine percent in total (n=12) expressed the view that responsiveness of the application was just “satisfactory” or “poor”, and 34% (n=14) gave one of these two responses when asked about overall ease of use of the application. On the whole, the distribution of responses to these items is encouraging however. The majority of the participants expressed high levels of satisfaction with all of the features listed, and although some were less positive about the overall ease of use and responsiveness of the application, these responses might be expected in this kind of trial, when participants are unfamiliar with the application and how to use it. Further, such features can be refined and improved in the further design of the application.

Views on Complexity and Accuracy of Religious Information

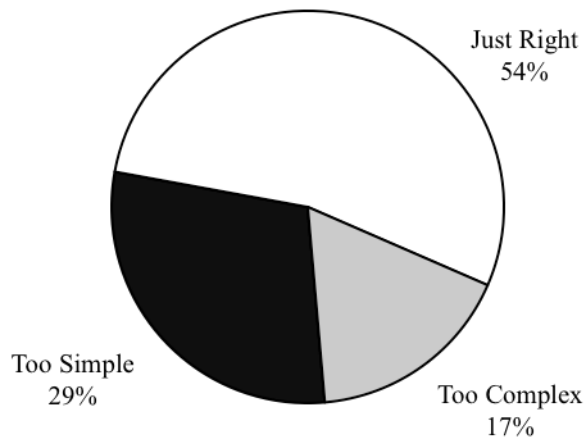


Figure 37: Perceived complexity of information (n=41)

It is possible that Saudi Arabian citizens will not use a religious smart phone application unless they perceive that the information it contains is reliable and easy to understand. Two of the questions were therefore designed to seek the participants' views on these two factors when using the prototype application. Figure 37 shows the distribution of responses to the question "is the religious information included in this application too complex, too simple or just right?" More than half (54%, n=22) indicated that they felt the information was "just right". The remainder was split between 29% (n=12) who indicated that the information was "too simple" and 17% (n=7) who expressed the view that the information was "too complex". Responses to this type of question are likely to reflect many factors including the user's educational level and existing familiarity with the information being presented in the application. Taking this into account, the overall distribution of findings is encouraging, indicating that the information is targeted at the right level for the majority of users in the target population.

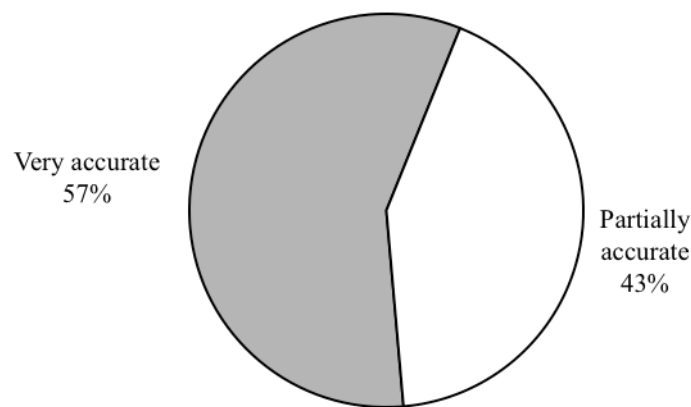


Figure 38: Perceived accuracy of information (n=41)

When asked to assess the accuracy of information contained in the application, 58% (n=23) of participants indicated that they felt this was "very accurate" but a substantial

minority (43%, n=17) said they felt the information was only “partially accurate”. None indicated that the information was “largely inaccurate” (Figure 38). Two of the participants took the opportunity to explain why they felt the information was only “partially inaccurate”, and both expressed the view that the information should be edited by an Islamic scholar. Although the information was extracted from an authoritative government source, this highlights the more general point that the content of applications must be perceived to be accurate and useful, especially when designed for use by older individuals who may already have a good knowledge of this information and be critical of any perceived shortcomings in it. This point will be incorporated in the recommendations for a final version of the application.

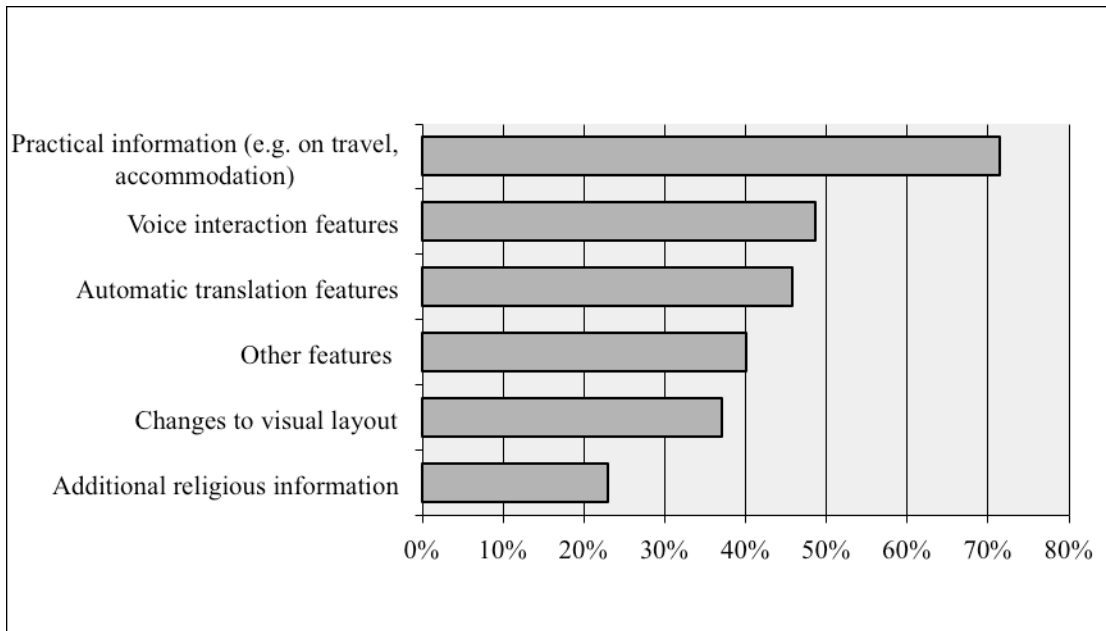


Figure 39: Suggested changes or additions to the application (n=41)

Finally, the research participants were asked if they would like to see any of a list of suggested changes or additions to the application, and also to explain their answer. Multiple

responses were allowed. Figure 39 shows the percentages of participants agreeing that each of the listed items should be addressed.

The most popular suggested addition was the inclusion of practical information, for example on travel or accommodation, with 71% (n=25) of participants expressing the view that this should be included in the application. However, this feature may be less relevant for Saudi Arabian senior citizens than for those pilgrims visiting from other countries. Twenty-three percent (n=8) said that additional religious information should be included.

The additional comments provided by participants with regard to the content of the application can be summarized as follows:

- Include more detailed information relating to supplications and stages of the pilgrimage
- Include videos and information about Arafaa day, one of the most important days during pilgrimage
- Include reminders of what to do at each stage and location during pilgrimage
- Include navigation maps
- Include bus and train maps and timetables
- Include estimated numbers of people at each holy venue visited by pilgrims

With regard to the design of the application rather than its content, relatively high percentages of participants expressed the view that there should be changes to the audio features of the application, with 49% (n=17) agreeing that voice interaction features should be included, and 46% (n=16) agreeing that the application should include automatic

translation features. Thirty seven percent (n=13) indicated that they felt changes to the visual layout of the application would be helpful.

The additional comments provided by participants with regard to the design of the application can be summarized as follows:

- Use larger fonts and icons
- Reduce number of buttons on some pages for simplicity
- Include more pictures
- Include illustrative videos

Finally, participants made a small number of additional comments about the application. One commented that it would be helpful if the local telecommunication company were to contact local and international pilgrims inviting them to install the application when they apply for pilgrimage or on arrival in Saudi Arabia, and also that the immigration department might provide overseas pilgrims with information about the application in advance. Two of the participants commented that they would have no use for the application as they felt the pilgrimage handbook is sufficient for their needs, and one commented that they were unable to see what is written on the screens.

Chapter Summary

This chapter has presented the findings of the evaluation of the religious prototype application, designed for use by Saudi Arabian senior citizens. Overall, the response of the research participants to the application was very positive, with a high percentage indicating that they would be interested in using an application like this in future, even if they had to

pay for the application. The participants also provided useful feedback regarding ways in which the content and design of the application might be improved. These findings are used in the concluding chapter of the thesis to develop recommendations for the final version of a religious application designed for use by Saudi Arabian senior citizens.

The following chapter presents the findings of the thematic analysis of the semi-structured interviews, which were designed to provide more detailed qualitative information on attitudes to smart phones and the factors influencing smart phone use among a small sample of Saudi Arabian seniors, to evaluate the relevance of existing models of technology adoption for understanding smart phone use among this group, and to investigate the influence of factors such as language and culture.

CHAPTER 6.

QUALITATIVE INTERVIEW RESULTS

This chapter presents the results of face-to-face interviews with a sample of 11 senior citizens in Saudi Arabia. The purpose of the interviews was to collect in-depth qualitative data on experiences of and attitudes to smart phone use among the participants, and build on the mainly descriptive data collected in the initial semi-structured survey. This enabled the researcher to address the research questions more fully and to identify ways in which the findings help address gaps in the existing literature on smart phone use among seniors, particularly relating to the influence of culture and language on the use of smart phones among seniors in a non-Western, Islamic country setting. Participants were selected using convenience-sampling methods, by asking the researcher's friends and other personal contacts to ask their relatives who are smart phone users aged 65 or over to take part. The resulting distribution of the sample by age, gender and type of smart phone used is shown in Table 2.

Table 2
Distribution of Interview Sample by Gender and Age

	Gender	Age	Smart Phone
Participant 1	Male	66	Samsung Galaxy Note 5
Participant 2	Male	65	Samsung Galaxy Note
Participant 3	Male	70	Samsung
Participant 4	Male	79	Samsung
Participant 5	Male	67	iPhone 4, iPhone 6
Participant 6	Female	65	Samsung Galaxy
Participant 7	Female	67	iPhone 4
Participant 8	Female	66	iPhone 6 plus
Participant 9	Female	68	Samsung Galaxy
Participant 10	Female	70	Samsung Galaxy
Participant 11	Female	74	Samsung Galaxy

The data were analyzed using thematic analysis methods facilitated by the use of the qualitative analysis software NVivo 11 (QSR, 2015). The findings are presented in the following sections by key themes relevant to the research questions, and are illustrated with translated verbatim findings from the interviews.

Smart Phone Use among Saudi Arabian Seniors

Previous studies from non-Islamic countries around the world have revealed that seniors tend to use a limited range of functions on their phones, either because of their perceived complexity, or because they do not see the benefits of doing so (e.g. Chan & Tsang, 2013; Chen, Chan & Ma, 2014; Lee, 2007). The semi-structured survey conducted as the first stage of this study confirmed that many Saudi Arabian seniors also use only a very limited range of smart phone functions, and the in-depth interviews provided an opportunity to investigate this further. Table 3 shows the functions or apps that the 11 interview participants reported using, arranged by rows in descending order of number of functions/apps used. Figure 40 portrays this data in a different way by showing the number of participants using each function, arranged in descending order of popularity.

Overall, these findings indicate that some of the participants were only using the types of functions that are also available on conventional cell phones. After the calling function, which was used by all 11 interviewees, WhatsApp was the next most commonly used function, with 8 of the 11 participants reporting that they use this app. However, a few participants were only using WhatsApp to read or reply to text messages, and two were only

using the alarm in addition to these functions. These are all features that can be used without the use of an app on conventional phones.

Table 3
Participants' Use of Smart Phone Functions/Apps (rows=participants)

No.*	Calls	Texts	Whats App	Snap Chat	Video calls	Google	News	You Tube	Alarm	Online services**	Camera
5	X		X		X	X	X	X	X		X
3	X		X		X		X	X			
6	X	X	X	X	X			X			
2	X		X		X					X	
8	X		X	X			X				
1	X		X					X			
10	X		X						X		
4	X								X		
7	X	X									
9	X		X								
11	X										

*Participant number

**For example, online banking, e-government services

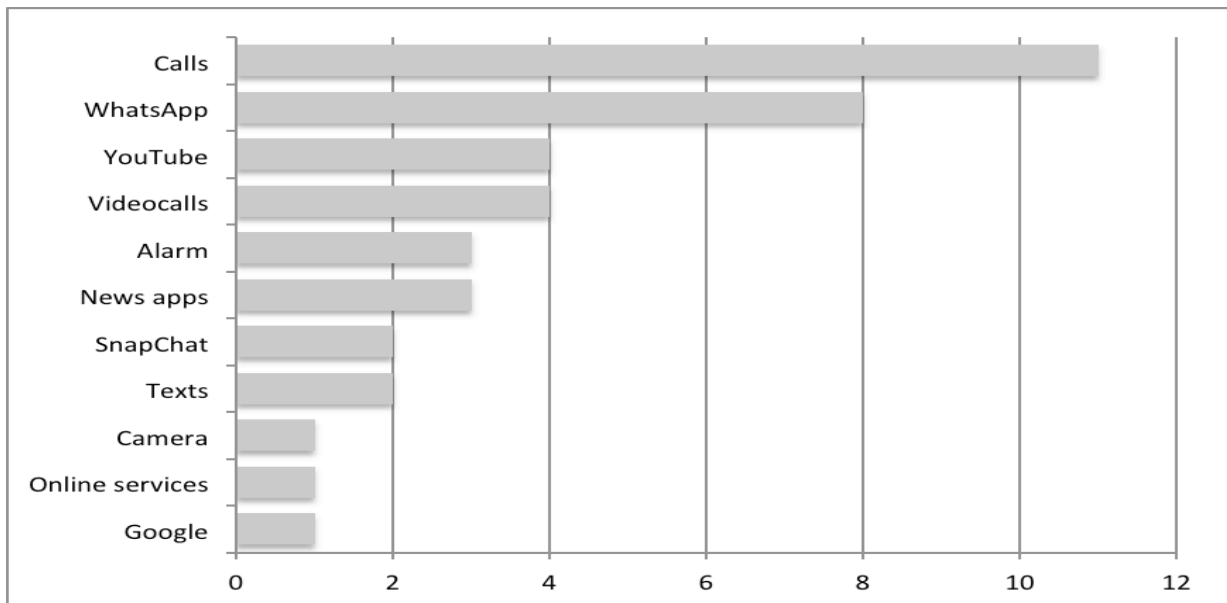


Figure 40. *Smart Phone Functions/Apps by Number of Users*

Others, however, were using WhatsApp more actively, and this appeared to be a common way in which these participants keep in touch with friends and relatives and share information, such as photos, videos or religious texts. Many participants reported a high level of daily usage of the calling and messaging functions of WhatsApp, with large numbers of calls and texts being made and received. With the exception of one participant who reported making and receiving a very large number of business calls on their smart phone, many of the others reported making or receiving at least 10 or more calls every day, as well as daily use of the WhatsApp messenger app. Several also indicated that they receive large numbers of WhatsApp messages with attachments including photos, videos and religious messages, which they sometimes forward to other contacts.

“I don’t text unless I receive advice or religious advice and I like it, then I forward it to others but this happens like once or twice a week. I receive a lot of texts, pictures and videos.” (Female, 66 years)

“I usually read what people send on groups and if it is something good like saying hi in the morning with something positive, advice, something religious or good video, I forward it to other groups or individuals.” (Male, 66 years)

Explaining why she uses WhatsApp and Snapchat in particular and smart phone in general, one female participant said:

“To communicate with my kids who are far away working in other cities. And to keep in touch with my relatives ... Also, I wanted to use it to call my daughter, who is in another city, and to video call my grandkids.” (Female, 65 years)

In total, four of the seniors reported that they use video calling apps such as Skype, but with the exception of the participant quoted above, who uses video calls daily to see and chat with her grandchildren, the others only reported doing so during times when family members were traveling or living overseas.

“When my son was in UK studying. He used to call me video and I respond.” (Male, 67 years)

The other reported uses of smart phones among this sample of Saudi Arabian seniors consisted of reading newspapers via apps, watching YouTube videos or using the camera. For the small number of participants that were more active and confident smart phone users, the ability to use these features appeared to have been quite an important influence on their decisions to start using a smart phone, providing support for the concept of “perceived usefulness” as included as an intervening variable in Davis’ (1989) Technology Adoption Model (TAM).

“I needed a phone with Internet. I wanted to see the news (mostly) online and watch YouTube clips.” (Male, 70 years)

“I bought it the first time because of the camera especially Samsung has good quality cameras. I use the camera for taking pictures of spare parts and email them to companies to buy them. Then, I knew about What’s app and it helped me a lot and it’s more convenient than email and faster to keep in touch with companies’ representative. Most businesses now are running online.” (Male, 65 years old)

None of the participants were actively using social media sites such as Facebook or Twitter, though one said they had a Facebook account but only use it to see what others are posting.

Lack of Confidence or Experience in Using Technology

Previous researchers have found that discovered that a lack of confidence or anxiety about using new technology frequently contributes to the low levels of usage of smart phones among seniors (e.g. Pan & Jordan-Marsh, 2010), and that there is a widespread perception among older users that these are difficult to use (Leburu, 2015; Lee, 2007). Perceived ease of

use (PEOU) was one of the other key intervening variables in the TAM (Davis, 1989). The findings of this study similarly revealed very low levels of confidence in using technology among these Saudi Arabian seniors, which appeared to influence their attitudes towards using smart phones. Indeed, most appeared to have had very little experience of using technology generally, with seven of the 11 participants indicating that they had never owned a computer. Only one participant (male, 65 years) appeared to be very confident in using technology; this was a businessman who indicated that he uses a laptop as well as his smart phone to search for new products and to use e-government services. The remaining participants generally reported being very unconfident about using new technology.

“I think I would be able to turn it (laptop or PC) on and off, but use it? I don’t think so, since I am not familiar with it.” (Female, 65 years)

“I feel I am illiterate in technology though I was math teacher but I retired. My students now know so much about these and I feel illiterate. I feel I can’t keep up with technology and I feel my intelligence is going backward.” (Female, 70 years)

“I think it was difficult (starting to use a smart phone) because I have never used any computer before and I was not familiar with the Internet.” (Female, 65 years)

Most of the participants reported considerable difficulties when first using smart phones, and said they were only doing so because of pressure from others; only two of the male participants gave personal reasons for choosing to use a smart phone, such as wanting to use the Internet or the phone camera. The remaining male and female participants had only started using a smart phone because they were given one as a gift or strongly encouraged by relatives or friends to use a smart phone, even if they were reluctant to do so.

“My daughters kept insisting on me to use it so they could send pictures and videos of their kids to me (my grandkids) when they go on a vacation/trip or travel. But still I am in love with the regular cell phone with buttons and it’s very usable and comfy and I want to go back and use it but my daughters won’t let me.” (Female, 70 years)

“I started using it because my friends kept insisting on me to use What’s App, which is not available in the regular cell phones. At first I didn’t want to use the smart phone but I felt isolated from my friends. I had to shift from regular phone to smart one ... After I used it, I like so much and I can’t stop using it now.” (Male, 66 years old).

This may reflect Saudi Arabia’s reported characteristic of being a high uncertainty avoidance culture, as individuals in these types of societies are unlikely to adopt new technologies unless recommended to do so by trusted personal contacts or until their widespread use is established in that society (Ameen & Willis, 2015).

Several of the participants, both male and female, described how they gradually familiarized themselves with the basic functions of their smart phone over time and found them easier to use. Only one, however, specifically indicated that he now thoroughly enjoys using a smart phone and would not go back to a traditional cell phone.

“I didn’t like the smart phone in the beginning and I didn’t want to use it but because it was a gift, I had to use it. But now I am in love with it and I am not going back to the regular cell phone at all. It has some many good apps. It’s not easy to shift but I am glad I shifted to the smart phone.” (Male, 67 years)

The other participants appeared to have experienced a much slower and more difficult process of learning to use a smart phone, which has only brought them to the stage of being able to use very basic features of the phone.

“It was difficult to use. To make/receive a phone call. But with practice and my kids taught me I learned how to use it.” (Female, 68 years)

“I am better because when I started I couldn’t even open messages but now I can open, read and delete the texts by my self but still I can’t text back.” (Female, 70 years)

“When someone used to call me, I didn’t know how to use the touch screen to respond to the call. Also, I couldn’t open text messages and type a new message to respond until my kids taught me. In addition, my daughter kept teaching me how to video call and I kept forgetting. It took me a while. Even though I think it is easy to use, I wasn’t familiar on how to use it. Also, because it was touch screen and

whenever I made a mistake, I had to start all over again.” (Female, 65 years)

The oldest interviewee, a male of 79 years old, indicated an extreme dislike for his smart phone, which had been given to him as a gift by his son, but was reluctant to stop using it for fear of hurting his son’s feelings.

“I didn’t want to be rude to my son and replace the smart phone he gifted me with the regular. He taught me how to open, call and close it. The next day, my son called me but I couldn’t answer. I got frustrated. When he got home, he taught me how to respond to a call. That’s enough. I hate this phone and I want my old regular phone but I don’t want to be rude to my son.” (Male, 79 years)

For those who did get used to their phone and were able to use at least its basic features, this did not seem to have increased their confidence in using technology more generally: they did not expect to be able to easily adapt to other models of smart phone.

“It took me a lot of time to learn how to use it and I don’t want any changes because I don’t want to learn how to use newer phone.” (Female, 70 years)

“It needs a lot of practice to get used to it. For example, now I am using Samsung phone, if I want to shift to iPhone it is not easy at all and it will take sometime.” (Male, 65 years)

Almost all of the participants also indicated that they rely very heavily on younger relatives or friends to teach them how to use their phone. This is similar to the finding of Leburu (2015), who reported an increased sense of dependency among older mobile phone users in South Africa. In the present study, many described ways in which they have needed the help of others, even with very basic smart phone functions such as texting, as well as more advanced functions such as online banking services or paying bills. Some commented on the advantages of these services but were not confident about using them themselves.

“Now I just know how to make/receive phone calls and open the WhatsApp to read messages but I need my daughters’ help to text for me. My daughters open the messages for me and I read them. And I tell them what to write and text back for me. But now I have improved I open the messages, read them and know how to delete them but still I don’t type texts and I don’t know how to text back.” (Female, 70 years)

“When I hear the phone rings for text message, I call my son to tell me who sends me and read his text, then I ask my son to write a message what I am telling him and respond to the sender.” (Male, 70 years)

“My son transfers money from my account from my phone but I don’t know how to do it my self.” (Female, 70 years)

Even one participant (male, 66 years) who reported extensive use of smart phone functions, and who had a laptop which he attached to his smart TV to watch videos, pictures and movies, admitted he did not feel confident when using technology and that “I need my friend’s help all the time to allocate the memory, do changes to the settings, etc.”

Practical Difficulties in Using Smart Phones

Previous researchers have documented a range of physical, cognitive and psychological difficulties often faced by senior citizens when using technological devices such as smart phones, which are often designed with younger users in mind (Charness, Kelley, Bosman & Mottram, 2001; Fisk et al., 2009; Leung et al., 2010). As noted in the literature review, there is a lack of consensus about the optimal design features to help older users avoid difficulties in using them, such as whether a keypad or touchscreen is more suitable (Cullen & Bratteteig, 2013; Häikiö et al., 2007; Kobayashi et al., 2011; Laguna, 2008; Murata & Iwase, 2005; Singh, Sharma and Aditya, 2012).

The participants in the current study did report considerable difficulties in using their smart phones, particularly the touchscreen, and almost all expressed a preference for a

keypad, of the type used on conventional cell phones. They described difficulties in using the touchscreen on their smart phone, citing reasons such as the screen being too small or the keys too close together, which indicates that both eyesight- and dexterity-related problems were affecting smart phone use among this group of Saudi Arabian seniors.

“It was difficult; I couldn’t move my finger properly on the screen.” (Female, 70 years)

“It took me long time to learn how to respond in touch screen. The previous regular phone is easier to use because I can respond by clicking on a button. Touch screen is confusing. I can’t get what I want. Mostly, I make mistakes using the touch screen.” (Male, 70 years)

“The keys are too small and I can’t see it properly and when I see the letter, I hit the letter next to it because the letters are too close to each other.” (Female, 68 years)

For some, the ability to increase the font size on their phone display had helped reduce the problems they were experiencing, which suggests that a larger font size and large touchscreen buttons, or ideally a key pad instead of a touchscreen, should be used in smart phone interfaces designed for older people in settings such as Saudi Arabia.

“The screen size is too small. In addition, we can’t type on this keyboard. As we age we can’t see properly. I am using larger font so I can read.” (Female, 66 years)

“I am enlarging the font to the max in my phone. We can’t see as good as younger people.” (Male, 65 years)

“I think if these phones have buttons instead of touch screens would be better and easier to use. The touch screen is quite fast responsive which doesn’t accommodate my shaky hand.” (Male, 70 years)

“The font and screen size should be larger because we can’t see properly.” (Male, 67 years)

Two of the female participants, however, expressed a high level of satisfaction with the interface and display of their smart phone, one an iPhone user and one a Samsung user.

For example:

Interviewer: “Do you think the iPhone design is good for Saudi Arabian seniors?”

Participant: “Yes, it’s easy to use”.

Interviewer: “How about the voice and visual appearance?”

Participant: “I think all looks good.” (Female, 67 years)

Language Related Influences on Use of Smart Phones

In the research setting of Saudi Arabia, an added consideration in the design of iPhones and apps for older people is language, since Arabic is the main language and many older people do not speak or read English, or only do so to a limited extent. Although an Arabic interface is now available for some smart phones and apps, some functions and apps only use English. Previous studies have found that individuals are most likely to do adopt technology and electronic services if they perceive these to be compatible with their own language as well as their culture (Al Ghaith et al, 2010; Harmon, 2015; Tan & Teo, 2000), so it was important to investigate this factor in the current study.

There was a mix of views among the participants in this study about the ease of using their smart phone with an Arabic interface. Two of the male interviewees (67, 65 years) expressed the view that the Arabic features of the phone are clear and easy to understand and use, although one female participant noted that the language was not clear until her daughter increased the font size on her phone (female, 68 years). Another participant, who uses a Samsung phone in which the Arabic features are more limited than on iPhones, found that this hindered his ability to use certain functions of his phone:

“Arabic language used in the phone is not understandable. I don’t get what they mean many times. I am not sure why. Maybe because my education level is elementary. Also, the app is mixed with both Arabic and English languages. I barely understand Arabic but not English. That’s difficult for me. I don’t know how to do changes to settings by myself because it’s in English, which I don’t understand.” (Male, 66 years)

One of the participants (male, 70 years) expressed the view that seniors in Saudi Arabia would be more likely to use smart phones if all apps were available in Arabic, and another commented that there are not enough apps currently available in Arabic, particularly for the purpose of online learning (female, 65 years).

A related factor relevant to developing countries compared to most Western countries is that some older people are still illiterate. One of the participants in this study could not read or write, and described how her son saved the contacts in order for her to be able to use her phone to make calls.

“My son saved his number and all numbers of my friends and relatives using symbols. For example, my son’s phone number is a star symbol, my daughter’s name is saved under heart symbol. This is how names are saved in my phone because I can’t read.” (Female, 74 years old)

This suggests that an additional consideration when designing apps and smart phones for use by seniors in developing countries, who may be illiterate, might be to incorporate non-language based features or apps based on symbols readily understandable to people in that cultural setting.

Cultural and Religious Influences on Use of Smart Phones

Researchers in other countries have found that many seniors prefer in-person communications and that this discourages them from adopting smart phones (Clark, 2002; Lindley, Harper & Sellen, 2009). Given that Saudi Arabia is reported to be a collectivist, high-context culture (Zakaria, Stanton & Sarker-Barney, 2003), it might be expected that seniors here would have a particularly strong preference for face-to-face communication, in which trust can be built and in which concise and often indirect verbal messages can be

readily understood. On the other hand, other studies have found that mobile phones play an important role in collectivist societies such as Saudi Arabia because of the ways in which they enable people to stay in frequent communication (Aldhaban et al., 2015). Ameen and Willis (2015) reported that text messaging is frequently used in the context of Islamic celebrations (Ameen and Willis, 2015).

The very heavy use of calling, texting and to some extent also forwarding and sharing information via smart phones among the participants in this study seems to support this point. For a number of participants, the main reason for using a smart phone or specific apps was to enable them to communicate more easily with friends or relatives and to keep in touch with what they are doing. On the other hand, several of the participants indicated that smart phones are having a negative impact on society in Saudi Arabia by reducing face-to-face communication.

“These apps divide you from your society. People don’t social face-to-face much as before and I don’t like that. I like the old way of socializing with people face to face ... It divides me from my kids and my relatives. All young people are using the smart phones all the time and I can’t talk with them face to face ... Now I get sad when my daughters keep using their phones all the time and I feel I am not with them though we live in the same house.” (Female, 70 years)

“It has drawbacks such as when my friends and I meet we use the WhatsApp for long time and not talk face to face even though we are sitting in the same room. I don’t like that at all.” (Male, 66 years)

“Seniors prefer socializing in real life than virtual life.” (Male, 67 years)

Although Saudi Arabia has a strongly collectivist culture, some of the participants demonstrated individualist traits by complaining that the sharing of photos and other personal information via WhatsApp, SnapChat and other smart phone apps is destroying privacy. This

demonstrates the complex linkages between cultural factors and individual behaviors, which must be taken into account when attempting to understand smart phone use.

“There is no private life anymore because I see my young relatives take videos of every thing they do.” (Female, 65 years)

“I am totally against posting everything on social media. It is not needed at all! I like privacy. I like to keep my private life to my self not to people ... I take pictures and videos for myself, not to show it on social media.” (Male, 65 years)

“My son is telling me he can watch our relative’s snaps and knows what they are doing at the moment such as hanging out in beach with their family. It’s their life and people are free to do what they want but still I think it’s silly and not needed. I think this a bad habit and there is no more privacy. Even if I learn how to use these technologies, I won’t show people what I am doing. I prefer my personal life to be private.” (Female, 67 years)

The findings of this study are also in line with those of other researchers who have found that the use of smart phones and their easy access to the Internet is often seen as a potential threat to traditional Saudi Arabian culture and its Islamic religious beliefs and values. However, another key finding of the present study is that the participants view smart phones as having the potential to both reinforce and threaten their religious and cultural values. Although their concerns about the potential of smart phones and the Internet for undermining religious and cultural values seem to be directed more at young people, this appears to influence their general attitudes towards smart phones.

“It’s not good for them to watch porn since I heard it’s easy for kids to access it especially in their teen age. The Internet is like a knife, which could be used for good or bad things. It all depends on the user. If you use it for good, it would improve your life style. On the other hand, if you use for bad things, it could destroy your life and endanger your family life especially in ISIS time.” (Female, 67 years)

“Kids could be playing violent games or games administrated by terrorist organizations like ISIS and brain wash kids’ minds. Or porn movies.” (Male, 70 years)

Interviewer: “Aren’t you afraid of using smart phones?” Participant: “Yes, I am afraid. Especially terrorist groups target kids using technology to get them to their groups. They manipulate their minds by watching snap video or some online videos. Even I heard they target them through network games.” (Male, 66 years)

Some specifically also noted that some older people may be reluctant to use smart phones because they associate these with access to the Internet, which they perceive as containing unethical content such as porn, which is seen to be inconsistent with Islamic values.

Interviewer: “Do you think in Saudi Arabia religious, social factors, etc. discourage elderly from using it?”

Participant: “Yes. Like porn movies, silly videos. It’s better to avoid ... I heard that some girls take naked pictures to send to boys using snap chat because they think it could be watched only once. This is not good religiously or ethically. I think it’s better to stay away from it.” (Female, 65 years)

“It has a lot of bad things”. Interviewer: “What do you mean by bad things?”

Participant: “Porn” (Male, 70 years)

“The kids or anyone don’t know what behind a button, it could be unethical website.” (Female, 66 years)

Overall, there seemed to be a general sense among many of the participants that older people have a greater understanding of how to use smart phones sensibly in ways that help promote rather than strengthen their religious values, however. For example, many of the participants in the present study indicated that one of their main uses of WhatsApp is the sharing of religious messages and texts with their friends, and some indicated that more emphasis on the religious benefits of smart phone use and the greater availability of religious apps might encourage the take up of smart phones by other seniors.

“I can tell them it has some religious advice which increases your faith.” (Female, 68 years)

“I think if they get to know that there are some religious, social apps, they would use it. But I think they are not aware of it, as I used it to be.” (Male, 66 years)

Several participants stressed that it is the way that the Internet and smart phones are used that determines whether there is a conflict with religious and cultural values. They emphasized that these phones have benefits particularly in terms of staying in communication with friends and family, but also involve risks in terms of easy access to unethical online information.

“It connects me with my loved ones. I use it in a good way and stay away from bad use like porn movies. If you use it right, then it is good. Otherwise, it’s bad.” (Female, 65 years)

“The smart phone is great invention. But you have to use it wisely and stay away from unethical videos.” (Female, 65 years)

“The Internet is an open world or sea. If you want knowledge, culture and benefits or if you want bad things you could find them all.” (Male, 65 years)

Interestingly, one of the participant’s responses revealed another religious/cultural factor that may have a negative impact on the adoption of smart phones in Saudi Arabia, not just among seniors but in general. She explained that, because it is not culturally acceptable for anyone to take photos of young women, many people keep a traditional cell phone for use when attending events or venues where cameras are not permitted, such as wedding ceremonies and educational institutions. It might be the case that individuals in Saudi Arabia may be more inclined to retain such a phone for regular use rather than adopting a smart phone, especially if, like the seniors in this study, they have little desire to use other smart phone functions or apps.

“I have regular cell phone; I take it to wedding hall because they don’t allow phones with cameras in weddings because no one would accept taking pictures of their daughters. Even my granddaughters can’t take phones with camera to the university

because the girls don't take pictures. They search the ladies and girls before you get in to the wedding hall.” (Female, 74 years)

Encouraging Other Seniors to Use Smart Phones

Although the smart phone functions used were fairly limited for the majority of the research participants, many were nonetheless able to identify the benefits of smart phone use. Keeping in touch with friends and family and sharing information were seen as especially important, and it was indicated that stressing and raising awareness of these benefits would be the main way of encouraging other Saudi Arabian seniors to use smart phones. When asked how they would persuade a friend to use a smart phone, the responses included:

“Taking pictures, sharing with people pictures, videos, and jokes using WhatsApp” (Male, 67 years)

“She could use it for useful things like keeping in touch with relatives, friends. Use other useful apps like religious, seeking online advice, educating your self online through YouTube clips ... connecting with your relatives who are far away, talk to your beloved ones, video calls. This new phone can do so many things.” (Female, 65 years)

“Communicating with family members when they are travelling, such as kids studying overseas. They would think about learning how to make video calls.” (Male, 65 years)

Many of these seniors also mentioned the benefits of being able to access online services, such as banking or paying bills, even though few were using these services directly and relying on family members to do so.

“My son does all the functions you mentioned from his phone. It's convenient and saves trip to the bank.” (Female, 65 years)

Although Saudi Arabia is reputed to have a high uncertainty avoidance culture in which individuals are reluctant to take risks, there was fairly little evidence of this in terms of a lack of trust in online services among the participants. The data in relation to this was

limited, but several of the participants expressed the view that e-banking is secure and that they have few concerns about holding online accounts.

Interviewer: “Aren’t you afraid from hacking your online banking account when you use it?”

Participant: “No no, it doesn’t happen.” (Female, 67 years)

Interviewer: “Aren’t you afraid that someone might hack your banking account?”

Participant: “No, because when I enter my username and password I get a text from the bank and secure code to enter it in their website to login.” (Male, 65 years)

Others were less confident and expressed concerns about the risks of online banking and the use of the Internet in general, views that are more aligned with what might be expected of older people in a high uncertainty-avoidance cultural setting.

Interviewer: “Are you afraid from paying bills online to be hacked?” Participant: “I don’t pay them by phone and I don’t want to.” Interviewer: “Don’t you want to learn?” Participant: “No.” (Male, 79 years)

“I am worried about if my privacy is protected or not? Is there anyone or an organization watching me? Could our phone calls, texts, picture and videos be exposed to anyone?” (Male, 65 years)

“You need to watch every digit when entering the account number, if you make a mistake the money would go to the wrong person.” (Female, 68 years)

When asked why other seniors do not use smart phones, two main types of response emerged: a general lack of interest in using smart phones, and a lack of awareness of their benefits.

The first response was given by participants who believe that most seniors have little interest in new technology and that the calling and texting features of cell phones are sufficient for them. This seems to reflect the uncertainty avoidance aspects of Saudi Arabian culture, which is perhaps more pronounced among older people who have been less exposed

than younger people to global influences on their traditional culture (e.g. via the Internet), and means that they see no reason to learn or adopt new ways of doing things.

“I think as people get older, they want to relax more than try to adopt new forms of technology. Their learning capabilities go down as they reach 50 and above. Seniors don’t like to be bothered with new technologies.” (Male, 65 years)

“I think because it’s not easy for them to download apps or create a new account. It’s bigger than their minds, which are not used to these technologies. We don’t care about new technology. We are usually old school and don’t like new technologies. I am more comfortable to watch from TV than YouTube.” (Male, 70 years)

“It’s not easy to convince seniors in our society of doing something new. They usually like what they used to and prefer not new things. I don’t think most of them would accept the change. Only the young people accept the change.” (Female, 65 years)

A smaller number of participants indicated that they believe other seniors do not use smart phones because they have not yet become aware of the benefits of doing so. These were the participants who had become more active smart phone users themselves, and had become convinced of their value compared with traditional cell phones.

“Maybe they don’t know to use it, or see benefits of using it - like me in the past before using it until my kids showed me and I saw the benefits.” (Female, 65 years)

“Perhaps because they don’t know the benefits of using it like me. If my son didn’t gift it to me, I wouldn’t know such a phone exists.” (Female, 67 years)

“Maybe because they don’t read or write, they don’t know WhatsApp exists” (Male, 66 years)

Chapter Summary

This chapter has presented the qualitative findings from in-depth interviews with a sample of 11 Saudi Arabian seniors, including both men and women aged 65 or over. The

interviews built on the earlier survey results to provide more detailed insights into these participants' views of and experiences of using smart phones, and into the cultural and language-related factors that have an influence on these. The findings have demonstrated that, in the Islamic setting of Saudi Arabia, cultural and religious factors influence smart phone use among seniors in a variety of ways, and can promote as well as hinder their use. Language has also been shown to be an important influencing factor, with many of the seniors not able to speak or read English and being restricted in their use of smart phones by the limited availability of features and apps using Arabic. In other respects, the experiences of these Saudi Arabian participants with regard to smart phone usage were similar to those of seniors studied in other countries, characterized in the main by low levels of confidence and very limited usage of smart phone functions. The final chapter summarizes the overall findings of the study, sets out recommendations for the design of smart phones for seniors in Islamic settings such as Saudi Arabia and for a revised theoretical model for the purpose of investigating smart phone use among these groups, and finally considers the limitations of the study and the wider implications of the research.

CHAPTER 7.**SUMMARY, RECOMMENDATIONS AND CONCLUSION**

This empirical study has investigated attitudes to and use of smart phones by senior citizens in Saudi Arabia, with the purpose of developing general guidelines for smart phone application design for this group. These results are intended to increase the take-up of smart phones among older people in Saudi Arabia enabling them to better access the benefits of mobile technology for seniors that are well documented in the literature. The study also contributes important new insights to the literature regarding the design of smart phone interfaces for seniors by taking account of the role of culture and language, and building on previous research conducted mainly in Western countries. The study was conducted in three stages: an interview survey of Saudi Arabian senior citizens was first conducted to investigate the use of smart phones among this group, and any difficulties which hinder their use. The survey findings were used to develop a prototype religious smartphone application, and this was evaluated by a second sample of research participants in the second stage of the study in order to finalize the recommendations for a smart phone application designed for use by senior citizens in Saudi Arabia. Finally, face-to-face semi-structured interviews were conducted with a sample of 11 seniors in Saudi Arabia, to generate more in-depth insights into the use of and attitudes to smart phones among this group and the ways in which cultural and language-related factors influence these.

Summary of Survey Findings

The survey revealed that there are relatively high levels of smart phone usage among the sample of Saudi Arabian senior citizens that participated in this study, compared with people of the same age range in other countries, and compared with the use by the sample participants of other forms of new technology. In line with previous studies conducted in other countries, this study found evidence that senior citizens experience difficulties in the use of smart phones, and would like modifications in their design to improve ease of use, particularly in relation to visual features. Some findings were more unique to this environment, such as the relatively frequent use of religious applications, and the suggestions of some participants for text and voice features in the Arabic language that are designed by native speakers. Among the participants who are not currently smart phone users there was little evidence from the research findings of likely future demand for smart phones, though this may reflect low levels of awareness of their potential benefits for older people.

Summary of Prototype Evaluation Findings

Based on the survey findings, a prototype religious application was developed, taking into account best practice design guidance from the literature as well as the survey responses relating to design factors, such as visual clarity. In stage two of the study, this application was evaluated by another sample of participants, many of whom had also participated in the survey. Overall, the response of the research participants to the application was very positive, with a high percentage indicating that they would be interested in using an application like this in future, even if they had to pay for the application. The participants also provided useful feedback regarding ways in which the content and design of the

application might be improved. For example, some expressed the view that the visual features of the application should be even clearer and that the interface could be simplified. Many of the participants also indicated that additional content should be included in the application, such as more detailed religious guidance and practical information on travel and accommodation for pilgrims visiting Mecca.

Interview Findings and Discussion

One of the main criticisms that have been made about leading theories of technology adoption is that they fail to take adequate account of the impact of contextual factors such as language and culture (Aldhaban, Daim & Harmon, 2015), focusing more on rational decision-making based on concepts such as perceived utility and perceived ease of use (e.g. Davis, 1989). Researchers have argued that since these models were developed in Western developed countries, they may not be applicable to non-Western environments because of the influence of cultural and language-related factors on the likelihood that individuals will adopt new technologies such as smart phones (Ameen & Willis, 2015; Hill, Loch, Straub, & El-Sheshai, 1998). Researchers have found that many of Hofstede's (1980) national culture dimensions are significant in predicting Web 2.0 use and demonstrated that technology adoption models alone do not adequately capture the variation between countries without taking account of these cultural factors.

In terms of Hofstede's national culture dimensions, Saudi Arabia has been shown to rank highly on uncertainty-avoidance trait which means that social influences can be expected to have a strong impact on technology adoption behaviors in this society (Ameen & Willis, 2015). It has also been widely defined as a "high context" culture in which close

personal relationships built on trust are very important, and which provide the context for indirect and implicit communications based on short, situation-dependent messages (Zakaria, Stanton & Sarker-Barney, 2003). Additionally, Saudi Arabian culture has a number of significant implications for inter-personal contact and communication, for example in the ways that direct contact between unmarried individuals of different genders is prohibited. It might be expected, therefore, that these cultural factors will have a strong influence on the adoption of smart phones in this setting, particularly among seniors. This group can in broad terms be expected to be less likely than younger people to have been exposed to global influences via the Internet, and also to be fully immersed in Saudi Arabian culture having lived there for many decades. Further, many older Saudi Arabians do not speak English, and since the availability of smart phones and apps in the Arabic language remains relatively limited, this is another factor which may have an influence on the adoption and use of smart phones among this group of older people. In-depth interviews with Saudi Arabian seniors therefore provided a valuable opportunity to address information gaps regarding the use of and attitudes towards smart phones among seniors in a non-Western, Islamic setting, and to identify ways in which cultural and language-related factors have an influence on these.

The interview research indeed provided evidence to support the argument that the collectivist nature of Saudi Arabia has a strong influence on the use of smart phones among the research participants. This was shown in several ways. First, almost all of the participants had started using smart phones in response to the pressure or encouragement of family members or friends, and not based on a personal decision-making process. One implication was that, although some had become positive and enthusiastic about smart phone use, many were still using their smart phones reluctantly in order to please others, and only using a very

limited range of functions such as calls and WhatsApp texts. The tendency for Saudi Arabian seniors to only adopt new technologies when persuaded to do so by existing users also reflects the uncertainty avoidance aspect of the culture, and provides support for the diffusion of technologies model, which showed that early adopters tend to be younger individuals (Rogers, 2003).

Second, it was found that the main use of smart phones among Saudi Arabian seniors is to stay in contact with and communicate regularly with relatives and friends. This includes people that the participants are in regular face-to-face contact with as well as those who are located further away. For many participants, these communications extended to viewing and forwarding attachments to WhatsApp messages, such as photos, videos or religious texts. In some respects, therefore, smart phones appear to be supporting and reinforcing the collectivist culture of Saudi Arabia by facilitating these forms of communication and information sharing. Although some of the participants only reported using the calling and texting function of their smart phone, which are also provided on conventional cell phones, the common use of WhatsApp to view and share attachments among these Saudi Arabian seniors suggests that the collectivist aspects of Saudi Arabian culture may have a positive influence on the adoption of smart phones among this group.

On the other hand, some participants expressed the view that smart phones are having a negative impact on their inter-personal relationships by reducing levels of face-to-face contact. This suggests that some aspects of the collectivist and high-context culture such as the widespread preference for direct, face-to-face communications may in some ways prevent a barrier to the adoption of smart phones among older people in this setting.

The strongly Islamic nature of Saudi Arabian culture similarly appears to have both positive and negative impacts on the use of and attitudes to smart phones among seniors. Many of the participants reported sharing religious material via their smart phones using WhatsApp, and some indicated that raising awareness of the opportunities to use religious apps and share Islamic information might encourage more Saudi Arabian seniors to use smart phones. On the other hand, there was clearly a widespread awareness of the potential risks that smart phones present to Islamic values, due to the ease of access to unethical content (such as porn) via the Internet. Some participants expressed the view that other Saudi Arabian seniors have been deterred from using smart phones because of their association with the Internet. Although not specifically referred to in the interviews, government censorship of the Internet and negative messages about the threats it poses to Saudi Arabian society may be contributing to or reinforcing these perceptions.

Although the uncertainty avoidance dimension of Saudi Arabian culture, as noted earlier, appears to be influencing patterns of smart phone adoption among seniors in this setting, there was less evidence from the interviews of an impact on attitudes to using online services. It might be expected that high uncertainty avoidance would be associated with high levels of concern about risks to personal privacy and security when using online services such as banking and paying bills, as identified by previous researchers in Saudi Arabia (Al-Ghaith et al., 2010; Shafi, 2002). Although a few participants did express these types of concerns, many appeared confident that online use of these services is secure, although most did not use these personally but relied on younger relatives to do so on their behalf.

As well as these cultural characteristics of Saudi Arabia, language is another aspect of this setting that may have an influence on the adoption of smart phones and other personal

technologies. Arabic is the first language of the Saudi Arabian population, but most technology interfaces and contents are designed primarily for English language speakers (Al Ghaith et al, 2010). As a result, researchers who have examined the adoption of e-services in Saudi Arabia have concluded that language is a major obstacle to this development (Al Ghaith et al, 2010), and this may also be true of smart phone adoption.

Many of the Saudi Arabian seniors interviewed for this study speak either no English or limited English, and were therefore using the Arabic interface and features of their smart phones. Only two expressed satisfactions with these: the remainder indicated that the Arabic features of their phones were unsatisfactory or were inadequate for their needs. This was particularly the case for the Samsung phone users, since this brand of smart phone only has features available partially in Arabic. When asked whether having more Arabic features would encourage other Saudi Arabian seniors to use smart phones, the participants generally agreed that this would be the case.

Overall, therefore the findings of the in-depth interviews confirm the need to incorporate cultural and language-related factors into theories and research about technology adoption among seniors in non-Western, developing countries, especially in conservative Islamic settings such as the society of Saudi Arabia.

Contribution of the Study

The overall contribution of the study has been to generate information for use in the design of smart phone interfaces and apps for Saudi senior citizens in order to promote increased uptake of smart phones among this group and ensure that it receives the benefits shown to be associated with smart phone use among seniors. As discussed in the literature

review, researchers have found evidence of a positive relationship between the use of technology and general levels of well-being among older people (Mitzner et al., 2010), and studies are revealing many ways in which smart phones and other computing devices are helping to prevent cognitive, sensory and motor decline among seniors, and enhancing their independence and daily functioning (Charness & Boot, 2009; Czaja et al., 2006; Ramon-Jeronimo, Peral-Peral, & Arenas-Gaitan, 2013). A study conducted by the Saudi Arabian Monetary Agency (Abusaaq, 2015) found out that people aged 60 or over will account for 25% of the Saudi Arabian population by 2015. It will therefore be increasingly important to address the mental and physical healthcare needs of this group, and smart phones and smart phone apps can provide important vehicles to help achieve this.

The study also helps to fill gaps in the existing literature in this area about smart phone use and barriers to use among senior citizens. There have been relatively few studies in this area internationally, and the current study therefore helps to address the claims of other researchers that there is insufficient research to date investigating the usability of smart phone interfaces for senior citizens (Barros et al., 2014; Kobayashi, 2011; Strengers, 2012). Further, most of the literature in this area to date has been primarily based on research with senior citizens in Western, English-speaking countries. Although previous researchers have developed best practice guidance and recommendations for the design of smart phone interfaces for older people, it has not been known to what extent these are applicable to senior citizens in other cultural and language settings. By conducting primary research among older people in Saudi Arabia, the study has been able to investigate this issue and provide information that enables existing best practice guidance to be tailored to the needs of this group. Although the research was conducted among senior citizens in Saudi Arabia, it

also helps to highlight the types of factors that might be investigated when developing smart phone interfaces and apps for use by seniors in other Middle Eastern or Islamic cultural settings.

On the whole, the study indicates that much of the existing best practice guidance on smart phone interface design for senior citizens is broadly applicable to senior citizens in Saudi Arabia. In particular, the study found evidence that senior citizens in Saudi Arabia experience difficulties in the use of smart phones, and would like modifications in their design to improve ease of use, particularly in relation to visual features. The findings also revealed that, based on the views and experiences of this sample, many senior citizens in Saudi Arabia have relatively low levels of usage of personal technology, little interest in learning about new technologies, and low levels of confidence in their abilities to use technology. This is aligned with the findings of research among senior citizens internationally (e.g. Pew Center, 2014), which revealed that many seniors face barriers such as a lack of confidence in using technology. It demonstrates that, like other senior citizen populations, a lack of interest in or lack of confidence in using technology may represent a barrier to the increased use of smart phones and apps among older people in Saudi Arabia, especially among those with lower levels of education. However, additional barriers in this setting include language difficulties, with very few features and apps being available in Arabic, and cultural barriers such as negative perceptions of the Internet which apparently deter some seniors from the use of smart phones.

The findings of this study were also aligned with those of previous researchers (e.g. Hong Kong, Chen, Chan & Tsang, 2013; Lee, 2007) which found that senior citizens use a limited range of smart phone functions, mainly making and receiving calls, sending or

receiving text messages and using messaging apps. These findings indicate that if senior citizens in Saudi Arabia are to secure the potential benefits of smart phone use, there is a need to design smart phones and apps in ways that help overcome these barriers. Since older populations in general are not heavy users of smart phones, this may have deterred smart phone manufacturers from developing interfaces and apps tailored to the needs of this group, which may in turn have increased uptake and usage.

However, the study also builds on the existing literature by identifying a number of ways in which the usage of smart phones by this group appears to differ from the smart phone usage among senior citizens identified in other studies. It revealed that, based on this sample, there may be higher rates of smart phone ownership and usage among senior citizens in Saudi Arabia (53%) than in the United States (30%, Anderson, 2015). This is an encouraging finding indicating that, with appropriate design of smart phones and apps to appeal to older users, it may be easier to promote high levels of usage among Saudi Arabian senior citizens than among western senior citizen populations. Previous researchers have found, however, that although older adults tend to be more selective in their use of technology and are slower to adopt new forms, they often become frequent users once they are familiar with the technology older users experience use of the Internet, they quickly become frequent users (cited in Lichtenstein, 2013; Olson, O'Brien, Rogers and Charness, 2010). In the present study, a significant minority of the survey respondents, especially those with higher levels of education, expressed a keen interest in learning about the latest technologies. Rogers (2003) established that "early adopters" often play a key role in the spread of a technology within a population. Within Saudi Arabia senior citizen population, promoting the use of smart phones and apps among those with a keen interest in technology,

and ensuring that they are designed in ways that are easy for most senior citizens to use, might be an effective way of encouraging uptake among the wider senior citizen population. The Saudi Arabian government, telecommunications companies and smart phone and app designers all therefore have a role to play in promoting awareness and usability of the features and potential benefits of smart phone use for older people. The interview findings also indicated that a potential barrier to the adoption of smart phones among seniors in this setting might be the lack of awareness of their benefits.

The study makes a theoretical contribution to the literature by helping to confirm that the Technology Acceptance Model (TAM) (Davis, 1989), with its emphasis on the variables “Perceived usefulness” and “perceived ease of use” is a valuable conceptual framework for research on the use of and attitudes towards smart phones among senior citizens in Saudi Arabia and might be adopted in future studies in this area. But the interview findings, which uncovered important cultural influences on the use of smart phones by seniors in Saudi Arabia, suggest a need to modify this model for use in this type of Islamic society by incorporating cultural factors as an independent variable.

The study has also built on the findings of earlier research into technology adoption and smart phone usage conducted among younger people in Saudi Arabia and among Arabic-speaking users in the West. These highlighted the need to modify smart phone interfaces to the local culture and language. One of the ways in which Saudi Arabian senior citizens were found to differ from their western counterparts is their relatively high level of usage, or interest in using, religious apps. To investigate this further, the second stage of the present study involved the development and trial of a prototype religious app. Along with the published best practice guidance on smart phone design for senior citizens, the results of this

trial were used to develop a set of practical recommendations, presented in the following section.

Practical Recommendations

Based on best practice design principles from the literature, as well as the findings of the survey and prototype application evaluation, it is recommended that any application intended for the target population of users, i.e. Arabic-speaking Muslim people aged 65 or over, should:

- Retain clarity and simplicity of layout, with a bright screen, clear contrast and sharp images
- Reduce number of buttons on each screen, and increase button size and spacing, for ease of navigation and responsiveness to touch (the literature indicates that touch panel buttons should be at least 16.5 x 16.5 mm in size, with spacing between buttons of between 3.17 mm and 12.7 mm).
- Incorporate photos and videos relating to practical content of the application, but avoid other moving graphics or flashing text
- Retain a large and clear font size (e.g. at least 12-14 pixels in Sans-serif fonts)
- Incorporate voice interaction and automatic translation functions
- Provide clear on-screen help and guidance on how to use the application and navigate between screens
- Incorporate additional and related practical information such as travel and accommodation options.

- Incorporate “live” and location-based information, e.g. on numbers of pilgrims currently at each location, and on available transportation options.

Recommendations for Future Research and Theory Development

The present study has revealed ways in which guidance for smart phone design for seniors, based on research conducted in Western settings, needs to be modified to meet the preferences and requirements of seniors in the non-Western, Middle Eastern setting of Saudi Arabia. The literature review revealed that relatively little research has been conducted internationally which has focused specifically on smart phone use among senior citizens rather than the use of other forms of new technology among this group. It is therefore recommended that future research in this area might include:

- Survey/interview-based research to investigate attitudes to and use of smart phones among senior citizens in a range of Western and non-Western cultural contexts; this will help generate information for use in refining best practice design principles that are widely relevant to the needs of senior citizens and can be tailored to specific national or cultural settings. The questionnaire developed for use in the present study might be adopted and modified as necessary for this purpose.
- Additional user trials and evaluations of smart phone applications designed for seniors, which might be based on individual interviews or focus group discussions, and focused on identifying the optimal technical specifications for such applications. Again, these might be conducted in a range of cultural settings, with the purpose of

identifying differences in optimum specifications between different groups of senior citizens.

- Quantitative surveys of smart phone use among senior citizens in a range of Middle Eastern or Gulf Cooperation Council countries, to identify similarities and differences between these country settings. This will help determine whether smart phone applications can be developed which meet the needs of senior citizens across the region, or whether they need to be tailored to specific populations of seniors on a country-by-country basis.

One of the main objectives of the study is to make recommendations for a revised model suitable for use in understanding the adoption of new technology among seniors in non-Western, developing societies. Previous studies with younger users and in business settings have confirmed the relevance of the widely used Technology Adoption Model (Davis, 1989) for use in understanding technology adoption in Saudi Arabia (e.g. Al-Gahtani, 2008). As discussed in Chapter 2, this built on earlier theories (Fishbein & Ajzen, 1975; 1980; Ajzen, 1991) which proposed that an individual's behavior in general is driven by his or her intention to perform an action, which in turn reflects the subjective norms of their society and their own attitude towards performing the behavior. The TAM applied the conceptual framework of these earlier models to the specific context of technology adoption, and identified two main attitudinal influences on technology adoption: perceived usefulness (PU), and perceived ease of use (PEOU).

Based on the findings of all three stages of this research, the PU and PEOU concepts appear to be highly relevant to an understanding of the use of smart phones among Saudi

Arabian seniors. It can be argued that the language related aspects of smart phone use, which were also found to be important in the current study, can be accommodated within the broader PEOU concept, since the perceived ease of use of a smart phone interface or app which is in English or Arabic will largely depend on a user's perceived level of fluency or difficulty in this language. However, the findings of this study clearly demonstrate the important role of cultural factors in both promoting and hindering smart phone use, and it is argued that the complexities of these apparent relationships (which could not be further explored using the qualitative methods of this study) mean that these cultural factors need to be incorporated more clearly as independent variable in theories of technology adoption targeted at understanding smart phone use among seniors in developing countries, particularly the strongly Islamic societies of the Middle East. The original TAM includes a category of "external factors", intended to include the "subjective norms" discussed in earlier models but also practical factors such as the available infrastructure, costs of technology etc. Since cultural and language factors were shown to be highly important, at least in qualitative terms, in the present study, it is proposed that the model should be revised to include separate variables based on dimensions of national culture (Hofstede, 1980). Figure 41 depicts the original TAM model (Davis, 1989), with this additional component. It is theorized, based on the findings of the present study, that cultural factors have a direct influence on perceived usefulness of smart phones (e.g. for frequent communications in collectivist societies, or for sharing religious messages in Islamic settings), but also a direct influence on attitudes towards using technology, for example due to a perceived conflict between religious/cultural values and the use of the Internet.

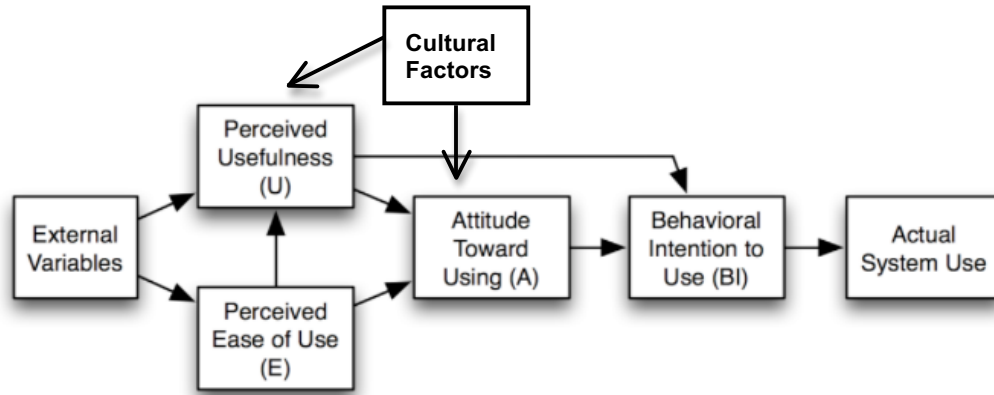


Figure 41: Proposed Revised Technology Adoption Model

It is argued that cultural factors should not be combined with other “external variables” since they interact in different ways with the other components of the model and appear to have a powerful influence on smart phone use among seniors in the Islamic research setting of the study, indicating that these factors should receive particular attention in future research with seniors in similar settings.

Limitations of the Study

One of the potential limitations of the study was that non-random methods were used to generate the samples of participants. The use of personal contacts and snowballing methods were considered to be the most effective and efficient ways of gaining access to a substantial number of Saudi Arabian senior citizens, and securing their participation in the study. Although it cannot be assumed that the participants are representative of the wider population of Saudi Arabian senior citizens, the resulting sample was diverse in terms of characteristics such as age, gender and educational level, indicating that the sample was not obviously biased in terms of excluding particular groups within this population of seniors.

Another limitation is that, although the broader topic of interest is the design of smart phones for senior citizens, the study only evaluated the design of one specific application. This is not a weakness of the study, since the application was designed in ways that incorporated a wide range of best practice guidance from the literature, as well as the findings of the survey.

Finally, the researcher was also the interviewer of participants in all stages of the study as well as the translator of the research material. This means that there is a possibility of unintended bias in the collection and interpretation of the research data based on the researcher's existing knowledge of the literature in this area and the expected findings. However, the potential for researcher bias was minimized by the use of a systematic approach to data collection and analysis and by taking steps to ensure that the researcher maintained a neutral and objective stance throughout the study.

Conclusion

The study makes an important contribution to knowledge about the ways in which best practice guidance in smart phone interface design needs to be prioritized and modified to meet the needs of Arabic-speaking senior citizens in the cultural setting of Saudi Arabia. To date, smart phone design has been largely dominated by the demands and preferences of younger users in Western, English speaking countries. As documented in the literature, older people often experience barriers and difficulties in the use of smart phones, many of which can be overcome by design factors. Senior citizens in non-Western countries in which English is not the primary language are likely to face additional barriers when using smart phones designed for Western users, but the existing guidance on smart phone design for

seniors does not take language and cultural factors into account. The findings of this study therefore provide important new insights into best practice smart phone design for seniors in Saudi Arabia, that are likely to increase the take up of smart phones among these groups. In turn, this will help ensure that they can better access the documented benefits of smart phone use for seniors, including positive impacts on mental functioning, improved independence and the adoption of healthier lifestyles through improved access to healthcare information.

The broad findings of the study also have wider significance and relevance for the design of smart phones for older users in a range of non-Western cultural settings. Additionally, the design of the study and its data collection instrument provide a model for further research that can be applied in a range of national and cultural settings, for use in determining the specific needs of older users and developing recommendations for smart phone interface design in these settings.

REFERENCES

- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg: Springer.
- Ajzen, I. (1991). The theory of planned behavior, organizational behavior & human. *Decision Processes*, 50(2), 179-211.
- Albugami, S., & Ahmed, V. (2016). Effects of culture and religion on the use of ICT in the Saudi education system. In *The IRES -13th International Conference on E-Education, E-Business, E-Management and E-Learning (IC4E)*, January 23rd, 2016, Istanbul, Turkey.
- Aldhaban, F., Daim, T. U., & Harmon, R. (2015). Exploring the adoption and use of the smartphone technology in emerging regions: A literature review and hypotheses development. In *Proceedings of the 2015 Portland International Conference on Management of Engineering and Technology (PICMET)* (pp. 2355-2370). Portland, OR: IEEE. doi:10.1109/picmet.2015.7273210
- Al-Gahtani, S. S. (2008). Testing for the applicability of the TAM model in the Arabic context. *Information Resources Management Journal*, 21(4), 1-26. doi:10.4018/978-1-60566-962-5.ch010
- Al-Gahtani, S. S., Hubona, G. S., & Wang, J. (2007). Information technology (IT) in Saudi Arabia: Culture and the acceptance and use of IT. *Information & Management*, 44(8), 681-691. doi:10.1016/j.im.2007.09.002
- Al-Ghaith, W., Sanzogni, L., & Sandhu, K. (2010). Factors influencing the adoption and usage of online services in Saudi Arabia. *The Electronic Journal of Information Systems in Developing Countries*, 40(1), 1-32.
- Al-Jumeily, D. & Hussain, A.J. (2014). The impact of cultural factors on technology acceptance: A technology acceptance model across Eastern and Western cultures. *International Journal of Enhanced Research in Educational Development*, 2(4), 37-62.
- Al-Mouh, N., & Al-Khalifa, H. S. (2015). The accessibility and usage of smartphones by Arab-speaking visually impaired people. *International Journal of Pervasive Computing and Communications*, 11(4), 418-435. doi:10.1108/ijpcc-09-2015-003
- Al-Saggaf, Y. (2004). The effect of online community on offline community in Saudi Arabia. *Electronic Journal of Information Systems in Developing Countries*, 16(2), 1-16.

- Al-Shohaib, K., Ali A.J. Al-Kandari, & Abdulrahim, M. A. (2009). Internet adoption by Saudi public relations professionals. *Journal of Communication Management*, 13(1), 21-36. doi:<http://dx.doi.org/10.1108/13632540910931373>
- Alwahaishi, S, & Snášel, V. (2013). Factors influencing the consumers' adoption of mobile Internet. In *The Third International Conference on Digital Information and Communication Technology and its Applications* (DICTAP2013), pp. 31-39.
- Ameen, N. & Willis, R. (2015). The effect of cultural values on technology adoption in the Arab countries. *NNGT International Journal of Information Systems*, 2, October 2015.
- Anderson, M. (2015, October 29). *Technology device ownership 2015*. Pew Research Center. Retrieved from <http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015/>
- Arning, K., & Ziefle, M. (2009). Different perspectives on technology acceptance: The role of technology type and age. In A. Holzinger, and K. Miesenberger (Eds.), *HCI and Usability for e-Inclusion* (pp. 20-41). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-10308-7_2
- Baker, E.W., Al-Gahtani, S., & Hubona, G. S. (2007). The effects of gender and age on new technology implementation in a developing country. *Information Technology & People*, 20(4), 352-375. doi:<http://dx.doi.org/10.1108/09593840710839798>
- Baltes, B., & Baltes, M. (1990). *Psychological perspectives on successful aging: The model of selective optimization with compensation*. New York: Cambridge University Press.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Barber, W., & Badre, A. (1998) Culturability: the merging of culture and usability. *Proceedings of the 4th Conference on Human Factors and the Web*, 1–14.
- Barnard, Y., Bradley, M. D., Hodgson, F., & Lloyd, A. D. (2013). Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. *Computers in Human Behavior*, 29(4), 1715-1724. doi:10.1016/j.chb.2013.02.006
- Barros, A. C., Leitão, R., & Ribeiro, J. (2014). Design and evaluation of a mobile user interface for older adults: Navigation, interaction and visual design recommendations. *Procedia Computer Science*, 27(2014), 369-378. doi:10.1016/j.procs.2014.02.041

- Barton S (2010). *Social and cultural factors that influence the uptake of E-learning: Case studies in Malaysia, Indonesia, Turkey, Singapore and Australia*. PhD Thesis, School of Business Information Technology, RMIT University, Melbourne, Australia.
- Belkhamza, Z. & Wafa, S. (2009) The effect of perceived risk on the intention to use e-commerce: The case of Algeria. *Journal of Internet Banking and Commerce*, 14(1), 1- 10.
- Bitterman, N., & Shalev, I. (2004). The silver surfer: Making the internet usable for seniors. *Ergonomics in Design: The Quarterly of Human Factors Applications*, 12(1), 24-28. doi:10.1177/106480460401200107
- Bjering, H., Curry, J., & Maeder, A. (2014). *Gerontechnology: The importance of user participation in ICT development for older adults*. doi:10.3233/978-1-61499-427-5-7
- Butt, S., & Phillips, J. G. (2008). Personality and self reported mobile phone use. *Computers in Human Behavior*, 24(2), 346-360. doi:10.1016/j.chb.2007.01.019
- Caine, E., Fisk, D., & Rogers, A. (2006). Benefits and privacy concerns of a home equipped with a visual sensing system: A perspective from older adults. In *Proceedings of the 50th Annual Meeting of the Human Factors and Ergonomics Society* (pp. 180–184). San Francisco, CA: HFES.
- Carmien, S., & Manzanares, A. G. (2014). Elders using smartphones: A set of research based heuristic guidelines for designers. In C. Stephanidis & M. Antona (Eds.), *Universal access in human-computer interaction: Universal access to information and knowledge* (pp. 26-37). doi:10.1007/978-3-319-07440-5_3
- Charness, N., & Boot, W. R. (2009). Aging and information technology use: Potential and barriers. *Current Directions in Psychological Science*, 18(5), 253-258. doi:10.1111/j.1467-8721.2009.01647.x
- Charness, N., & Holley, P. (2004). The new media and older adults: Usable and useful? *American Behavioral Scientist*, 48(4), 416–433. doi:10.1177/0002764204270279
- Charness, N., & Schaie, K. W. (Eds.). (2003). *Impact of technology on successful aging*. New York: Springer.
- Charness, N., Kelley, C. L., Bosman, E. A., & Mottram, M. (2001). Word-processing training and retraining: Effects of adult age, experience, and interface. *Psychology and Aging*, 16, 110–127. doi:10.1037/0882-7974.16.1.110
- Chen, K, Chan, H.S., & Tsang, N.H. (2013). Usage of mobile phones amongst elderly people in Hong Kong. In *Proceedings of the International MultiConference of Engineers and Computer Scientists 2013 Vol II* (pp. 1016-1019). Hong Kong: IMECS. Retrieved from http://www.iaeng.org/publication/IMECS2013/IMECS2013_pp1016-1019.pdf

- Chen, K., & Chan, A. H. (2011). A review of technology acceptance by older adults. *Gerontechnology, 10*(1), 1-12. doi:10.4017/gt.2011.10.01.006.00
- Chen, K., Chan, A., & Ma, Q. (2014). Cell phone feature preferences among older adults: A paired comparison study. *Gerontechnology, 13*(2), 184. doi:10.4017/gt.2014.13.02.068.00
- Clark, D. J. (2002). Older adult living through and with their computers. *CIN: Computers, Informatics, Nursing, 20*(3), 117–124.
- Cullen, A. L., & Bratteteig, T. (2013). Touch-screens and elderly users: A perfect match? In L. Miller (Ed.). *ACHI 2013: The Sixth International Conference on Advances in Computer-Human Interactions* (pp. 460-465). IARIA.
- Czaja, S. J. (2005). The impact of aging on access to technology. *ACM SIGACCESS Accessibility and Computing, 83*(3), 7-11. doi:10.1145/1102187.1102189
- Czaja, S. J., & Lee, C. (2007). The impact of aging on access to technology. *Universal Access in the Information Society, 5*(4), 341-349. doi: 10.1007/s10209-006-0060-x
- Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., & Sharit, J. (2006). Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging, 21*(2), 333–352.
- Dale, O., & Schulz, T. (2011) *Oslo: Norsk Regnesentral 2011*. Retrieved from <http://publ.nr.no/5658>
- 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
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of information technology. *MIS Quarterly, 13*(3), 319. doi:10.2307/249008
- Dickinson, A., Arnott, J., & Prior, S. (2007). Methods for human – computer interaction research with older people. *Behaviour & Information Technology, 26*(4), 343-352. doi:10.1080/01449290601176948
- Dix, A., Finlay, J., & Abowd, G.D (2004). *Human-computer interaction* (3rd ed.). Harlow, UK: Pearson Education.
- El Said, G. R. & Galal-Edeen, G. H. (2009) The role of culture in e-commerce use for the Egyptian consumers. *Business Process Management Journal, 15*(1), 34-47.

- Emdad, A. F., Badamas, M., & Mouakket, S. (2009). Factors and impacts of low utilization of internet: The case of Arab countries. *Journal of International Technology and Information Management*, 18(3), Article 2.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research* (pp. 561-562). Reading: Addison-Wesley.
- Fishbein, M., & Ajzen, I. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.
- Fisk, A. D., Rogers, W. A., Charness, N., Czaja, S. J., & Sharit, J. (2009). *Designing for older adults: Principles and creative human factors approaches*. Boca Raton: CRC Press.
- Fox, S. (2004). *Older Americans and Internet*. Retrieved from www.pewinternet.org/files/old-media/Files/Reports/2004/PIP_Seniors_Online_2004.pdf
- Gregor, P., & Newell, A. F. (2001). Designing for dynamic diversity. Proceedings from 2001 EC/NSF Workshop on Universal Accessibility of Ubiquitous Computing Providing for the Elderly - WUAUC'01. doi:10.1145/564526.564550
- Häikiö, J., Isomursu, M., Matinmikko, T., Wallin, A., Ailisto, H., & Huomo, T. (2007). Touch-based user interface for elderly users. Proceedings from *MobileHCI*, Singapore.
- Hawthorn, D. (2000). Possible implications of aging for interface designers. *Interacting with Computers*, 12(5), 507-528. doi:10.1016/s0953-5438(99)00021-1
- Heinz, M. S. (2013). Exploring predictors of technology adoption among older adults. *Graduate Theses and Dissertations: Paper 13155*. Retrieved from <http://lib.dr.iastate.edu/etd/13155>
- Hernández-Encuentra, E., Pousada, M., & Gómez-Zúñiga, B. (2009). ICT and older people: Beyond usability. *Educational Gerontology*, 35(3), 226-245. doi:10.1080/03601270802466934
- Hill, C.E., Loch, K.D., Straub, D., & El-Sheshai, K. (1998). A qualitative assessment of Arab culture and information technology transfer. *Journal of Global Information Management*, 6, 29- 38.
- Hofstede, G. (1980). *Culture's consequences: International differences in work-related values*. Beverly Hills, CA: Sage Publications.

- IJsselsteijn, W., Nap, H. H., De Kort, Y., & Poels, K. (2007). Digital game design for elderly users. In *Proceedings of the 2007 conference on Future Play* (pp. 17-22). Toronto: ACM.
- Jakobs, E.-M., Lehnen, K., Walter, M., Vogt, O., & Ziefle, M. (2008). *Alter und technik. eine studie zur altersbezogenen wahrnehmung und gestaltung von technik*. Aprimus.
- Jin, Z., Plocher, T., & Kiff, L. (2007). Touch screen user interfaces for older adults: Button size and spacing. In C. Stephanidis (Ed.), *HCI 2007. LNCS, Vol. 4554* (pp. 933–941). Heidelberg: Springer.
- Kaplan, A. M. (2012). If you love something, let it go mobile: Mobile marketing and mobile social media 4x4. *Business Horizons*, 55(2), 129-139. doi:10.1016/j.bushor.2011.10.009
- Khasawneh, B. A. (2014). Usability challenges to Arabic mobile phones interface in bilingual environment. In *Proceedings of the International conference on Computing Technology and Information Management* (pp. 324-330). Retrieved from www.sdiwc.net/digital-library/web-admin/upload-pdf/00001049.pdf
- Kobayashi, M., Hiyama, A., Miura, T., Asakawa, C., Hirose, M., & Ifukube, T. (2011). Elderly user evaluation of mobile touchscreen interactions. In P. Campos, N. Graham, J. Jorge, N. Nunes, P. Palanque, & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2011, Vol. 6946* (pp. 83-99). doi:10.1007/978-3-642-23774-4_9
- Kurniawan, S. (2008). Older people and mobile phones: A multi-method investigation. *International Journal of Human-Computer Studies*, 66(12), 889-901. doi:10.1016/j.ijhcs.2008.03.002
- Laganà, L. (2008). Enhancing the attitudes and self-efficacy of older adults toward computers and the internet: Results of a pilot study. *Educational Gerontology*, 34(9), 831-843. doi:10.1080/03601270802243713
- Lawhon, T., Ennis, D., & Lawhon, D. C. (1996). Senior adults and computers in the 1990s. *Educational Gerontology*, 22(2), 193–201. doi:10.1080/0360127960220205
- Leburu, K. (2015). *Older persons' competence to use mobile phones: An exploratory study* (Unpublished master's dissertation). Retrieved from https://dspace.nwu.ac.za/bitstream/handle/10394/15896/Leburu_K_2015.pdf?sequence=1
- Lee, B., Chen, Y., & Hewitt, L. (2011). Age differences in constraints encountered by seniors in their use of computers and the internet. *Computers in Human Behavior*, 27(3), 1231-1237. doi:10.1016/j.chb.2011.01.003

- Lee, Y. S. (2007). *Older adults' user experiences with mobile phones: Identification of user clusters and user requirements*. Retrieved from https://theses.lib.vt.edu/theses/available/etd-09172007-135013/unrestricted/Dissertation_YSL.pdf
- Leitão, R. (2012). *Creating mobile gesture-based interaction design patterns for older adults: A study of tap and swipe gestures with Portuguese seniors*. Retrieved from https://www.researchgate.net/publication/257004572_Creating_Mobile_Gesture-based_Interaction_Design_Patterns_for_Older_Adults_a_study_of_tap_and_swipe_gestures_with_Portuguese_seniors
- Leitão, R., & Silva, P.A. (2012). Target and spacing sizes for smartphone user interfaces for older adults: Design Patterns based on an evaluation with users. In *Proceedings of the 19th Conference on Pattern Languages of Programs*. The Hillside Group. Retrieved from <http://dl.acm.org/citation.cfm?id=2831275&CFID=677111940&CFTOKEN=30777721>
- Leitão, R., & Silva, P.A. (2013). *A study of novice older adults and gestural interaction on smartphones*. In *Proceedings of MOBACC 2013: Mobile Accessibility Workshop at CHI 2013*. Retrieved from http://mobile-accessibility.di.fc.ul.pt/papers/mobacc2013_submission_6.pdf
- Leung, R., Findlater, L., Mcgreneire, J., Graf, P., & Yang, J. (2010). Multi-layered interfaces to improve older adults' initial learnability of mobile applications. *ACM Transactions on Accessible Computing*, 3(1), 1-30. doi:10.1145/1838562.1838563
- Lichtenstein, C. (2013). Technology use by senior citizens [Opinion]. *IEEE Technology and Society Magazine*, 32(1), 18-19.
- Lindley, S. E., Harper, R., & Sellen, A. (2009). Desiring to be in touch in a changing communications landscape. *Proceedings from CHI '09: The 27th International Conference on Human Factors in Computing Systems*. doi:10.1145/1518701.1518962
- Lorenz, A., & Oppermann, R. (2009). Mobile health monitoring for the elderly: Designing for diversity. *Pervasive and Mobile Computing*, 5(5), 478-495. doi:10.1016/j.pmcj.2008.09.010
- Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J.,... & Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in Human Behavior*, 26, 1710-1721. doi:10.1016/j.chb.2010.06.020
- Morrell, R. W., Mayhorn, C. B., & Bennett, J. (2000). A survey of World Wide Web use in middle-aged and older adults. *Human Factors*, 42(2), 175-182. doi:10.1518/001872000779656444

- Motti, L. G., Vigouroux, N., & Gorce, P. (2015). Improving accessibility of tactile interaction for older users: Lowering accuracy requirements to support drag-and-drop interaction. *Procedia Computer Science*, 67(2015), 366-375. doi:10.1016/j.procs.2015.09.281
- Murata, A., & Iwase, H. (2005). Usability of touch-panel interfaces for older adults. *Human Factors*, 47(4), 767-776.
- Nicolau, H., & Jorge, J. (2012). Elderly text-entry performance on touchscreens. Proceedings from ASSETS '12: *The 14th International ACM SIGACCESS Conference on Computers and Accessibility*. doi:10.1145/2384916.2384939
- Nischelwitzer, A., Pintoffl, K., Loss, C., & Holzinger, A. (2007). Design and development of a mobile medical application for the management of chronic diseases: Methods of improved data input for older people. In A. Holzinger (Ed.), *USAB 2007, LNCS, Vol. 4799* (pp. 119–132).
- Pak, R., & McLaughlin, A. (2010). *Designing displays for older adults*. Boca Raton, FL: CRC Press.
- Pan, S., & Jordan-Marsh, M. (2010). Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. *Computers in Human Behavior*, 26(5), 1111-1119. doi:10.1016/j.chb.2010.03.015
- Petrovčič, A., Vehovar, V., & Dolničar, V. (2016). Landline and mobile phone communication in social companionship networks of older adults: An empirical investigation in Slovenia. *Technology in Society*, 45(May), 91-102. doi:10.1016/j.techsoc.2016.02.007
- Ramon-Jeronimo, M. A., Peral-Peral, B., & Arenas-Gaitan, J. (2013). Elderly persons and internet use. *Social Science Computer Review*, 31(4), 389-403. doi:10.1177/0894439312473421
- Rivière, V., M., Haddad, M., & Philippe, V. W. (2010). The impact of national culture traits on the usage of Web 2.0 technologies. *Vine*, 40(3), 334-361. doi:http://dx.doi.org/10.1108/03055721011071458
- Rogers, E. M. (2003). *Diffusion of innovations*. New York, NY: Free Press.
- Rosales, A., & Fernández-Ardèvol, M. (2016). Beyond WhatsApp: Older people and smartphones. *Romanian Journal of Communication and Public Relations* 18(1), 27-47. doi:10.21018/rjcpr.2016.1.200
- Rose, G. & Straub, D. (1998). Predicting general IT use: Applying TAM to the Arabic world. *Journal of Global Information Management* 6(3), 39–46.

- Rosenthal, R. (2008). Older computer–literate women: Their motivations, obstacles, and paths to success. *Educational Gerontology*, 34, 610–626.
- Shafi, I.M. (2002). *Assessment of the impact of Internet technology use among Saudi business organizations*. Ph.D. dissertation, Mississippi State University, United States: Mississippi.
- Sharma, S., Singh, P., Sharma, R., & Mahajan, A. (2012). Age based user interface in mobile operating system. *International Journal of Computer Science, Engineering and Applications*, 2(2), 177-184. doi:10.5121/ijcsea.2012.2215
- Silver, C. (2001). Older surfers. *Canadian Social Trends*, 63, 9–12.
- Strengers, J. (2012). *Smartphone interface design requirements for seniors*.
- Tan, M. & Teo, T.S.H. (2000). Factors influencing the adoption of Internet banking. *Journal of the Association for Information Systems*, 1, 1-42.
- Tang, H.-H., & KAO, S.-A. (2005). Understanding the user's model of the elderly people while using mobile phones. Proceedings of *HCI '05*.
- Trompenaars A., Hampden-Turner, C. (1997). *Riding the waves of culture: Understanding cultural diversity in global business*. London: Nicholas Brealey
- Turner, P., Turner, S., & Walle, G. V. (2007). How older people account for their experiences with interactive technology. *Behaviour & Information Technology*, 26(4), 287-296. doi:10.1080/01449290601173499
- United Nations (2015). *World Population Ageing*. Retrieved from http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Vicente, P., & Lopes, I. (2016). Attitudes of older mobile phone users towards mobile phones. *Communications*, 41(1), 71-86. doi:10.1515/commun-2015-0026
- Vroman, K. G., Arthanat, S., & Lysack, C. (2015). “Who over 65 is online?” Older adults’ dispositions toward information communication technology. *Computers in Human Behavior*, 43, 156-166. doi:10.1016/j.chb.2014.10.018
- Zakaria, N., Stanton, J. M., & Sarker-Barney, S. (2003). Designing and implementing culturally-sensitive IT applications: The interaction of culture values and privacy issues in the middle east. *Information Technology & People*, 16(1), 49.

APPENDIX A. SURVEY QUESTIONNAIRE

Introductory Text:

The research is about the use of smart phones among senior citizens in Saudi Arabia. Even if you do not currently own a smart phone, I am still interested in your views.

A smart phone is defined on Google as “a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, Internet access, and an operating system capable of running downloaded apps.” Is this type of phone familiar to you? (if respondent is uncertain, explain further).

First, please could you tell me if you currently own and use a smart phone? Yes/No

If “Yes” ask questions in Section A

If “No” ask questions in Section B

All interviewees to be asked questions in Section C

SECTION A (current smart phone users only)

1. Which of the following brands of smart phone do you currently own and use?

Apple iPhone

Samsung

LG

HTC

Sony

Nokia

Blackberry

Motorola

Asus

Google

Other – please specify

2. How long have you owned your current smart phone?

Less than 1 year

1 to 2 years

More than 2 years

3. How long in total have you been using a smart phone (taking into account all smart phones you have ever owned)?

Less than 1 year
1 to 2 years
More than 2 years

4. How important are each of the following factors to you when purchasing a smart phone?

Very important Fairly important Not important

Price
Brand
Design/style
Range of functions and features
Screen size
Clarity of visual display
Large icons and text display
Quality of camera
Operating system
Technical specification (e.g. RAM, processor size, data storage)
Network connectivity options
Range of apps available
Other - please specify

5. For each of the following items, please indicate how often you use your smart phone for this purpose.

Often Sometimes Rarely/never

Making or receiving calls
Sending or receiving text messages
Sending or receiving emails
Participating in a video call (e.g. Skype or Facetime)
Sending or receiving messages via apps (e.g. Whatsapp, Facebook Messenger)
Taking and storing photographs
Using social media (e.g. Facebook, Twitter, Snapchat, Instagram)
Checking the weather
Browsing/searching for information on the Internet
Reading online newspapers
Reading e-books
Listening to downloaded music
Listening to online radio stations
Watching videos (e.g. YouTube)
Playing games
Online banking
Using E-government services
Booking flights or hotels
For religious purposes

Using the clock or alarm
 Using maps or satellite navigation
 Using apps
 Other (please specify)

6. Do you ever experience difficulties when using any of the following features of your smartphone?

	Often	Sometimes	Rarely or never
Touch screen			
Keyboard			
Visual display			
Sound/speakers			
Internet connectivity			
Telephone signal			
Overall size or shape of phone			

7. If you indicated that you often or sometimes experience difficulties when using any of the features of your smart phone, please briefly describe these difficulties below:

(text box included here for qualitative response)

8. In general, how would you rate the ease of use of your smart phone, where 1 is “very difficult” and 5 is “very easy”.

1 2 3 4 5

9. In general, how easy was it to set up your smartphone account, where 1 is “very difficult” and 5 is “very easy”.

1 2 3 4 5

10. Are there any additional features or functions you would like your smartphone to include, which are missing at present?

(text box included here for qualitative response)

11. Do you have any health-related problems that affect your ability to use the functions of your smartphone? If yes, are these mainly (tick relevant response):

Eyesight-related?
 Hearing-related?

Neurological?
 Mental health related?
 Other (please specify)?

SECTION B (non smart phone users only)

1. Do you regularly use any other type of mobile/cell phone: Yes / No
2. What are the reasons why you do not own a smart phone (tick all that apply)?

Cost
 Do not need the functions of a smartphone
 Not interested in a smart phone
 Other - please specify
 Don't know

3. Imagine that someone gave you a smart phone as a gift. How likely is it that you would use the smart phone for the following purposes?

Very likely Fairly likely Unlikely

Making or receiving calls
 Sending or receiving text messages
 Sending or receiving emails
 Participating in a video call (e.g. Skype or Facetime)
 Sending or receiving messages via apps (e.g. Whatsapp, Facebook Messenger)
 Taking and storing photographs
 Using social media (e.g. Facebook, Twitter, Snapchat, Instagram)
 Checking the weather
 Browsing/searching for information on the Internet
 Reading online newspapers
 Reading e-books
 Listening to downloaded music
 Listening to online radio stations
 Watching videos on YouTube
 Playing games
 Online banking
 Using E-government services
 Booking flights or hotels
 For religious purposes
 Using the clock or alarm
 Using maps or satellite navigation
 Using apps
 Other (please specify)

4. If you were buying a new phone in future, how likely do you think you would be to choose a smart phone:

Very likely
 Fairly likely
 Not very likely
 Not at all likely

5. If you were buying a smart phone in future, how important would each of the following be in your choice?

Very important Fairly important Not important

Price
 Brand
 Design/style
 Range of functions and features
 Screen size
 Clarity of visual display
 Large icons and text display
 Quality of camera
 Operating system
 Technical specification (e.g. RAM, processor size, data storage)
 Network connectivity options
 Range of apps available

SECTION C (all interviewees)

Finally, please answer the following questions:

1. What is your gender (interviewer to record without asking question)

Male
 Female

2. Which age group do you belong to?

Under 65
 65 to 69
 70 to 79
 80 or over

3. What is your marital status:

Single
Married
Divorced
Widowed

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

No formal education
Primary education
High school education
College or technical education
Bachelor's degree
Master's degree
Advanced graduate study or PhD

5. How interested are you in learning about the latest technologies:

Very interested
Fairly interested
Not interested

6. Which of the following forms of technology do you use regularly?

Desktop computer
Laptop computer
Tablet
Smartphone
Smart TV

7. How confident do you feel in your ability to use computers and the Internet?

Very confident
Fairly confident
Not very confident
Not at all confident

Thank you very much for participating in the research.

APPENDIX B: PROTOTYPE APP EVALUATION QUESTIONS

Please explore the Prototype religious app using the software provided, and then answer the following questions:

1. Overall, how likely is it that you would use a smart phone app like this:

- I would definitely use this app if available for use with my current smartphone
- I would purchase a new smartphone in order to use an app like this
- I would be unlikely to use an app like this

2. Which of the following best describes your own view on this app:

- I would be prepared to pay for the use of this app
- I would only use this app if it were free of charge
- I would definitely not use this app, even if it were free

3. How popular do you think this app would be among the following groups:

	Very popular	Fairly popular	Not popular
Pilgrims aged 65 from outside Saudi Arabia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pilgrims aged below 65 from outside Saudi Arabia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Saudi Arabian citizens aged 65 or older	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Saudi Arabian citizens aged below 65	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Please indicate how simple or complex it was to use the following features of the prototype app:

	Very easy	Fairly easy	Fairly difficult	Very difficult
Finding relevant information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Navigating between screens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using menu buttons/touchscreen operation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Size of icons and display	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Text content	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Please indicate your views on the standard of the following features of the app:

	Very good	Good	Satisfactory	Poor
Overall ease of use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Responsiveness to touch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall visual effects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Images used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Textual content	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. In your view, is the religious information included in this app:

Too simple	<input type="checkbox"/>
Just right	<input type="checkbox"/>
Too complex	<input type="checkbox"/>

Please briefly explain your answer

.....

7. In your view, is the religious information included in this app:

- Very accurate
- Partially accurate
- Largely inaccurate

Please briefly explain your answer

.....

**8. What changes or additions would you like to see (if any) in this app?
(you can tick more than one box)**

- Practical information (e.g. on travel, accommodation)
- Additional religious information
- Changes to visual layout
- Voice interaction features
- Automatic translation features
- Other features (please specify)

Please briefly explain your answer

.....

**9. Do you have any other comments on your experiences of exploring this
prototype app?**

.....

Thank you very much for participating in this trial

APPENDIX C: IN-DEPTH INTERVIEW GUIDE

Introductory Text

Thank you for agreeing to take part in this interview. The purpose of my research is to explore the ways in which people aged over 65 in Saudi Arabia use smart phones, and how they feel about this type of technology. It is for the purpose of my doctoral study, and the findings may also be published in a journal.

I am defining a smart phone as a hand held device that can be used not just for making and receiving calls and texts, but also for accessing the Internet and using a range of applications. Based on your survey results, I understand that you currently own a smart phone, is that correct?

In this interview I would like to find out more about your use of smart phones and other new technologies. There are no right or wrong answers; I am only interested in hearing about your personal views and experiences. If you do not understand any of the questions, please ask me to clarify these. The interview is likely to take around (30 to 60 minutes?)

Do you have any questions about the study at this stage?

Section 1: Background and Contextual Information

- 1. First of all, please could you briefly describe your current smart phone, for example the brand and age of the phone?**
- 2. On a typical day, which of the functions of this smart phone do you use?**

Prompt if necessary:

- Making calls
- Receiving calls
- Sending and receiving texts
- Using social media (which?)
- Using apps (examples)

Section 2: Attitudes to Technology

- 3. Please think back to when you first started using a smart phone. Roughly how long ago was this?**

How would you describe your level of familiarity and confidence with computer technology in general at that time?

Prompts: Did you already own a desktop computer or laptop?
 Roughly how often did you use this computer and why?
 How confident did you feel about using computer technology?
 Would you say you were more or less confident than most of your friends with computers at that time, or about the same?
 Other?

4. Can you please explain why you first started using a smart phone?

Prompts: Attracted by the range of features and apps available?
 A specific purpose? (please explain)
 Friends or relatives were already using smart phones?
 Persuaded by a friend or relative to buy a smart phone?
 Like to try the latest technology or gadgets?
 Any other?

5. If you were trying to persuade a friend to buy their first smart phone, what reasons would you give?

Prompts: Ease of calling or texting
 Ease of accessing the Internet at any time
 Specific apps – e.g. maps, radio, weather, news, religious apps
 Other?

6. How did you feel about using a smart phone when you first owned one? Please explain your answer: what made you feel this way?

Prompts: Excited
 Confident
 Nervous / unconfident
 Overwhelmed
 Other feelings?

- 7. Did you experience any specific difficulties when starting to use a smart phone? If so, please can you describe these difficulties? Were you able to resolve these, and if so, how?**

Prompts:

- Using the controls
- Navigating menus
- Making calls or sending texts
- Accessing the Internet
- Understanding the language used
- Using apps
- Other

- 8. How would you say your use of a smart phone has changed over time? And how have your feelings about using the smart phone changed?**

Prompts:

- More or less confident
- Use of more or less functions/apps (which ones?)
- Other changes

- 9. In your view, is your smart phone well designed for use by an older person in Saudi Arabia?**

If yes, why do you say this?

If no, what changes would make your smart phone more suitable for use by an older person in Saudi Arabia?

Prompts:

- Are the phone controls easy to use?
- Are the phone controls easy to understand?
- Is the visual display clear?
- Is the sound quality satisfactory?
- Are you able to clearly understand the language (controls/apps)
- Does the range of features and apps meet your needs?

Section 3: Influencing Factors

10. **Researchers in other countries have found that many older people don't use smart phones, or that they use only basic functions like making calls and sending texts. Why do you think this might be? Please explain your answer.**

Prompts: No perceived need for other functions or apps
 Lack of confidence in using other functions or apps
 Difficulties in using other functions or apps
 Lack of suitable apps for this group
 Other?

11. **Do you think older people in Saudi Arabia also have low rates of smart phone use, compared with younger people?**

If no, please explain your answer.

If yes, why do you think some older people in the KSA are not interested in using smart phones or smart phone apps, in your view? Please explain.

Prompts: No perceived need for them
 Lack of confidence in using them
 Difficulties in using them
 Lack of suitable apps for this group
 Poor infrastructure (e.g. Broadband coverage)
 Communication preferences
 Concerns about privacy / other risks
 Lack of Arabic language features or apps

12. **Can you suggest any ways in which seniors in Saudi Arabia might be encouraged to make more use of smart phones?**

If language or culture is not mentioned, follow up with:

Do you believe that seniors in Saudi Arabia might be encouraged to make more use of smart phones if the interfaces or apps used Arabic rather than English. Please expand on your answer.

Do you believe that seniors in Saudi Arabia might be encouraged to make more use of smart phones if more religious (Islamic) apps were available? Please expand on your answer.

13. Do you believe that there are any other factors relating to the religious or cultural values of Saudi Arabia that discourage some seniors from using smart phones? Please expand on your answer.

14. Do you personally think that smart phones are a good way to communicate with your relatives or friends, or do you prefer to use other forms of communication? Please think about this with regard to different groups of relatives or friends, and explain your answer.

Prompts: Benefits of communicating via smart phone

Drawbacks of communicating via smart phone, with:

Younger relatives

Relatives of a similar age to the participant

Friends of a similar age

Other preferred communication methods and reasons for these

15. Do you personally think that using a smart phone is a useful way of accessing the Internet to find out information? Are there any risks or difficulties in doing so, in your view? Please explain your answer.

Prompts: Compare using a smart phone with using a computer/laptop/tablet

Ask for examples of using their smart phone to access information, and

How easy or difficult this was.

Explore any concerns about the risks of accessing/using the Internet

16. Do you think smart phones are a useful way of accessing the Internet for purposes such as paying bills, doing banking or accessing government services? Are there any risks or difficulties in doing so, in your view? Please explain your answer.

Prompts: Compare using a smart phone with using a computer/laptop/tablet

Ask for examples of using their smart phone for these purposes, and

Ease or difficulty of accessing services via smart phone
Explore any concerns about the risks of accessing services (e.g. privacy, data security)

17. Finally, do you have any other comments about the use of smart phones by seniors in Saudi Arabia, or on your own experiences of using a smart phone?

Concluding Text

That is the end of the interview, thank you very much for participating in the research. Would you like to ask me any further questions about the study?

APPENDIX D: IRB APPROVALS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1135 Pearson Hall
Ames, Iowa 50011-2207
515 284-4569
FAX 515 284-4207

Date: 10/21/2016
To: Muath Khawaji
1218 S 4th St.
Ames IA
CC: Dr. James Oliver
1620 Howe Hall
From: Office for Responsible Research
Title: Smart phone use among Saudi Arabian senior citizens
IRB ID: 16-446
Study Review Date: 10/20/2016

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

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

The determination of exemption means that:

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

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

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

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

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

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

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2220 Lincoln Way, Suite 202
Ames, Iowa 50014
515-294-4566

Date: 3/8/2017

To: Muath Khawaji
1218 S 4th St.
Ames IA

CC: Dr. James Oliver
1620 Howe Hall

From: Office for Responsible Research

Title: Smart phone use among Saudi Arabian senior citizens

IRB ID: 16-446

Approval Date: 3/7/2017 **Date for Continuing Review:** 3/6/2019

Submission Type: New **Review Type:** Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

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

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 202 Kingland, to officially close the project.

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

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 8/18/2017

To: Muath Khawaji
1218 S 4th St.
Ames IA

CC: Dr. James Oliver
1620 Howe Hall

From: Office for Responsible Research

Title: Investigating Saudi Arabian Seniors' use of and views on smart phones: qualitative research

IRB ID: 17-386

Approval Date: 8/18/2017 **Date for Continuing Review:** 8/17/2019

Submission Type: New **Review Type:** Expedited

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- Complete a new continuing review form at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

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

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 202 Kingland, to officially close the project.

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