SMARTPHONES ADOPTION AND USAGE BY 50+ ADULTS IN THE UNITED KINGDOM

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1 Introduction

Over the years, the capabilities of Information and Communication Technologies (ICTs) have significantly advanced. Advances in ICT devices, such as, laptops, tablets and smartphones, have made them become important to the business, educational and personal lives of individuals by providing information that is expedited, easily accessible and manageable (Line et al., 2011). Smartphones began to take off after 1996 with developments offered by the novel forms of mobile phones leading them to become one of the fastest evolving technologies in the mobile phone market.

Benefits of smartphones include the provision of information and knowledge on entertainment, travel, finance, healthcare, and social networks (Xu et al., 2011). Since its introduction, there has been an exponential increase in the consumer market. For instance, in the year 2015, statistics showed that there were approximately 2 billion smartphone users in the consumer market and this number was further estimated to increase to approximately 3 billion by 2020 (Statista, 2017). In the United Kingdom (UK), the numbers of smartphone owners have increased continuously with present statistics revealing that smartphone ownership was in four out of five adults (81%) or 37 million individuals having a smartphone in the period up to June 2016. In penetration terms there were rises by just seven per cent in

the year to June 2016, compared to nine per cent in 2015, 13% in 2014 and 19% in 2013 and it is anticipated that user numbers will peak and have very modest rises in the coming years (Deloitte, 2016).

In demographics terms, a global trend that is evident is an aging population. Due to medical advances and better quality of life, individuals are living longer (UN DESA, 2009). In the UK, individuals aged 65 or over increased by 3.9% between 1974 and 2014, from 13.8% of the UK population to 17.7%. This proportion is projected to increase by a further 6.6% of the UK population by 2039 (OFS, 2016). Therefore, individuals belonging to the older population group are increasing. In this research, the term silver surfer is defined as an individual who is 50 years old and above (Netlingo, 2010). Due to improved quality of life and better economic conditions within families, some older adults are still working or becoming entrepreneurs; thereby owning and managing enterprises (Meyer, 2013). It is within this context that smartphones may also provide assistance.

Older adults are usually at risk of being lonely and socially excluded (Stewart et al. 2013, 15). Previous studies suggest that smartphones can significantly improve personal relationship, reduces loneliness and hence offer pathways to social inclusion (Park et al., 2013). Moreover, Cho (2015, 350) found that using smartphone apps play a vital role in aiding social inclusion and thus, improve the quality of life of people. Further, smartphones may provide benefits in terms of health care for retired individuals (Joe and Demiris, 2013), and a reduction in loneliness by connecting older adults with their friends and family (Blažun et al., 2012).

Additionally, the older adult population is a likely group of adopters of smartphones, but there are still many who have not adopted this device; thereby offering a motivation to pursue this research. For this purpose, the aim of this chapter is *to identify, examine and explain the*

adoption and usage patterns of smartphones in the UK within the 50 years old and above population.

The contributions of this research include enhancing the understanding of adoption and use of mobile telephony within the UK's older adult population. For practitioners, this research identifies factors that will encourage or inhibit the acceptance of smartphones among this group. For policy makers, this research is beneficial as it forms an understanding of smartphones devices, which can inhibit or encourage more interaction with government and other organisations such as smartphone providers and developers. To familiarise readers, the following section provides the literature review and a conceptual framework related to older adults, smartphones and smartphone adoption research. This is then followed by a presentation of the research model, the research methodology, and the results. Finally, the chapter closes with a discussion of the results, their implications for other research and some conclusions.

2 Literature review

When considering the theoretical foundation of older adults and smartphones, gaps that exist within the older generation, the digital divide, mobile phones and smartphones research areas were initially identified.

2.1 Older adults and digital divide

The divisions between individuals, society groups and nations in terms of their associations with ICTs are varied, but are widely known as a 'digital divide' (Tsatsou, 2011). The following definitions are those widely agreed to capture nature of the phenomenon of the digital divide. The digital divide is commonly defined as the divide between "those who have access to a particular technology and those who do not" (Curwen and Whalley 2010: 210). It

is also posited that "the digital divide is the 'uneven diffusion' or 'gap' or 'disparities' between different socio-economic levels or across countries or between developed and developing nations in terms of 'access to' and 'use (usage)' of ICTs" (Hwang 2006:19). When considering "the digital divide" a 'typical' description refers to Internet access, but the term has been broadened to include other ICTs and a wide range of adoption parameters that go beyond access (Anheire and Toepler, 2010).

The digital divide has provoked immense debates that have resulted in it being considered in a variety of contexts including, socio-economic status, gender, age, racial, region or geography (Tsatsou, 2011). One significant component of the digital divide is age (Selwyn et al., 2003). Having lived many years in the world without the Internet older adults tends to perceive the Internet as 'non-essential'. Additionally, age related problems such as declining vision, cognitive and chronic diseases are posed as major challenges to overcome. This has resulted in a significant age-based divide between young and old, with Internet use largely decreasing in the older group (Greengard, 2009).

Over the years, many researchers have examined older adults' applications of and benefits of novel technologies (Vroman et al., 2015). From previous studies of ICTs adoption and usage patterns in older adults, various aspects were brought to light. One aspect included the digital divide where the gap between individuals who have used ICTs and those who have not used ICTs was examined (Barnard et al., 2013). Concurring with these studies is a study that found the existence of a digital divide and the gap is not likely to close anytime soon (Kim, 2011). Digital divides can occur due to older adults facing difficulties when adopting novel technologies (Lee et al., 2011). In a study of a 55 years old and above population of Finland, it was found that around one-third of the respondents do not use the Internet (Vuori and

Holmlund-Rytkönen, 2005). In Australia, within silver surfing individuals the Internet is used five times less than the under 30s age group (Willis, 2006).

Several studies have attempted to investigate this issue and identify the factors leading to the age related digital divide. Factors included the perceived lack of benefits (Heart and Kalderon, 2013), lack of interest or motivation (Fu, 2013), lack of knowledge (Peacock and Künemund, 2007), lack of access (Peacock and Künemund, 2007), cost (Carpenter and Buday, 2007), and physical limitation (Saunders, 2004).

2.2 Mobile phones and Smartphones

As smartphone technology continues to advance, research findings are continuously emerging (Aldhaban, 2012). For instance, a 2000 study of a digital divide in mobile phones and Internet revealed the occurrence in terms of age, gender, income, work status and education was evident (Rice and Katz, 2003). Furthermore, similarities in the adoption and use of mobile phones and the Internet were apparent (Rice and Katz, 2003). Research was also conducted on the health related information differentials in gender terms and revealed that within silver surfer females, age is a significant factor given that older adults are less aware of novel technologies (Xue et al., 2012). In 2011, a study of health and caregiving in the silver surfer population identified that 79% of the silver surfers owned mobile phones, but only 7% adopted smartphones. It was also found that within this age group, approximately half of the silver surfers used or intended to use mobile technology for health related matters. In terms of using this technology for health purposes, 11% of the sample population used it for basic health matters such as, weight, blood sugar and blood pressure measurements (Barrett, 2011). Such studies assisted this research to recognize the benefits of smartphones for the older population and identified the gaps in adoption studies.

2.3 Theory building

The core concept of this research is adoption and use. In terms of the Information Systems (IS) discipline and adoption research, it was identified that research in this area has matured, but studies related to adoption are still developing. The main theories applied in adoption studies are the Diffusion of Innovation (DoI) (Rogers, 2003); Unified Theory for the Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2012); Technology Acceptance Model (TAM) (Davis, 1989) and Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980). Additionally, the factor of Perceived Enjoyment was adopted from previous studies and applied in this research (Song and Han, 2009).

To determine the theories for this research, a review of various IS adoption theories were conducted. It was found that TAM is the most popular, followed by UTAUT and TRA (Aldhaban, 2012). However, there was also a pattern of combining two or more IS theories. For instance, DoI and TAM were combined to explain the adoption of smartphones in a logistic industry (Chen, et al, 2009). This pattern was also applied in medical studies examining the adoption of smartphones among medical practitioners (Park and Chen, 2007). UTAUT and Enjoyment were combined to examine the importance of Enjoyment in mobile services (Song and Han, 2009). Based on this, the study applied this pattern of combining theories to provide a better understanding of the research problem.

2.4 Research model

The proposed conceptual framework assumed that the dependent variable of behavioural intention to use smartphones is influenced initially by Observability and Compatibility that have been drawn from DoI (Rogers, 2003). The second group of constructs include, social influence, facilitating conditions, performance expectancy and effort expectancy that are

drawn from UTAUT (Venkatesh et al., 2012). Thirdly, Perceived Enjoyment (Chtourou and Souiden, 2010) is also integrated in the model. Finally, the dependent variable actual use (ACU) is influenced by the intention to use smartphones. Usage was measured using the features of a smartphone, such as, e-mailing, browsing, using social media, taking a photo and playing games.

DoI: Observability

An innovative product can be defined as a new product where the features are novel or improved significantly from the predecessors. The contemporary features may develop using innovative technologies, knowledge or materials currently available (Rogers, 1998). Therefore, smartphones can be considered to be an innovative product because firstly, they were introduced in 2007 with advanced designs and sophisticated technologies such as, an iPhone (Honan, 2007). Secondly, they had applications and immense advanced features compare to a feature phone. Therefore, Rogers's DoI is applied to this framework.

Observability (OBS) is defined as the degree that smartphones are visible to silver surfers. Previous studies related to smartphones also identify that Observability is important for technology adoption (Koenig-Lewis et al., 2010). Therefore, from DoI, this research posits that there is more likelihood of silver surfers adopting smartphones when they see a smartphone being used. Thus the following hypothesis is proposed.

H1: Observability has a positive influence on the behavioural intention of smartphone adoption among silver surfers.

DoI: Compatibility

Compatibility (COM) is also drawn from DoI, which is defined as the degree that a smartphone is compatible with silver surfers lifestyles (Rogers, 1998). Smartphones can benefit users in many ways such as, business and personal communication and information on

health issues (Chang et al., 2016). Therefore, smartphones may be compatible with the silver surfers' lifestyles, which led to the following hypothesis being proposed.

H2: Compatibility has a positive influence on the behavioural intention of smartphone adoption within silver surfers.

UTAUT: Social Influence

Social influence (SOC), one of the factors drawn from UTAUT can be defined as the degree to which an individual perceives that other individuals important to the person, such as, family, friends or other close peers believe that the person should use the new system (Venkatesh, 2012). It was found that silver surfers adoption of new technologies is normally influenced by other individuals, particularly, those who are close to them; for instance, their family and friends (Berner et al, 2015). Previous studies associated with smartphones also show that SOC is important for technology adoption (Bouwman and Reuver, 2011). Therefore, the following hypothesis is proposed.

H3: Social Influence has a positive influence on the behavioural intention of smartphone adoption among silver surfers.

UTAUT: Facilitating Conditions

Facilitating conditions (FC) drawn from UTAUT can be defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a smartphone (Venkatesh, 2012). This factor is described as older adults having necessary resources, such as knowledge, time and money to adopt smartphones (Zhou et al, 2010). However, as with any novel technology, users who want to adopt a smartphone will need to have some understanding when using a new device. Additionally, in terms of cost, if a fee for using the smartphone is affordable and viewed as most beneficial to the silver surfers, then a positive attitude may occur and the older adults can use this technology. From previous

research on mobile acceptance, the construct FC is viewed as one of the main factors leading to acceptance or adoption (Zhou et al., 2010). Therefore, the following hypothesis is proposed.

H4: Facilitating Conditions have a positive influence on the behavioural intention of smartphone adoption among silver surfers.

UTAUT: Performance Expectancy

Also drawn from UTAUT, Performance Expectancy (PE) is defined as the degree to which an individual believes that using the system will help him or her to achieve completion of their jobs or tasks (Venkatesh, 2012). Theory also revealed that performance is one of the factors that affect user behavioural intention (Venkatesh, 2012). UTAUT identifies a user's perception of the benefits of a smartphone as, mobility, Internet connection, and application. If older users recognize the potential benefits that a smartphone provides, then they are likely to adopt and use a smartphone. Therefore, the following hypothesis is proposed.

H5: Performance expectancy has a positive influence on the behavioural intention of smartphone adoption among silver surfers.

UTAUT: Effort Expectancy

Effort expectancy (EE), is defined as the degree of ease associated with the use of a system (Venkatesh, 2012). EE reflects the perceived effort construct when users adopt a new system. This factor is comparable to the perceived ease-of use construct of TAM and the complexity construct from DoI (Venkatesh et al., 2003). It explains a user's perception of the difficulty associated with using a smartphone. If using a smartphone is considered to be a difficult task, then fewer older adults will adopt and use it. This research postulates that older adults may have different perspectives that need to be studied. Therefore, the following hypothesis is proposed.

H6: Effort Expectancy has a positive influence on the behavioural intention of smartphone adoption among silver surfers.

TAM3: Perceived Enjoyment

Perceived enjoyment (ENJ) drawn from TAM3 is defined as the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use (Venkatesh, 2012). A smartphone, which has additional capacities such as, connecting older adults with friends and family, playing music, watching videos, installing and playing games, and surfing some entertaining content, can be a device that provides enjoyment to older adults. ENJ was found to significantly affect the intended use of new technology (Rouibah et al., 2016). This factor was studied in both the contexts of using software in smartphones (Verkasalo et al., 2010) and using mobile Internet especially for shopping (Agrebi and Jallais, 2015). Thus, this research believes that older people may find smartphones enjoyable in many ways. Therefore, the following hypothesis is proposed.

H7: Perceived Enjoyment has a positive influence on the behavioural intention of smartphone adoption within silver surfers.

Behavioural Intention/ Use Behaviour

From UTAUT (Venkatesh, 2012), Behavioural Intention (INT), the level to which a person has formulated a conscious plan to use a device in the future. It is the middle factor between the dependent variables and use behaviour. INT is considered to influence the adoption or usage of the smartphones in this research. Previous research applying UTAUT presented a relationship between the dependent variables and INT (Venkatesh et al., 2003).

Also, studies suggest that old people fear using unfamiliar technology such as, mobile phones (Kurniawan, 2008). However, with stronger intentions, the larger benefits of smartphones for

old people especially health care (Joe and Demiris, 2013), appropriate learning time and environments can lead to the acquisition of technology knowledge similar to the younger generation (Chaffin and Harlow, 2005). Therefore, the following hypothesis is proposed.

H8: Behavioural intention has a positive influence on the smartphone usage of silver surfers.

To illustrate and understand the combination of factors, their relationships and the formed hypothesis, a structural model was formed, as shown in Figure 15.1.

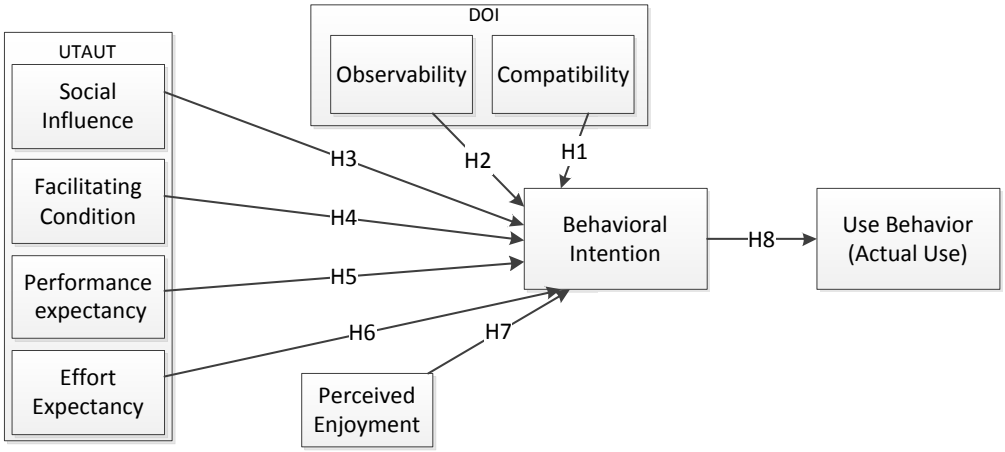

Figure 15.1. Research Model and Hypotheses

This research also recognizes the moderating variables of gender, age, experience and voluntariness in usage of smartphones (Venkatesh, 2012). However, adding variables increases the number of hypothesis. Therefore, this research will discuss three of the main moderator variables that are gender, age and experience in the results section (Nysveen et al., 2005). Moreover, as ageing occurs, adults face health problems, which led to the inclusion of the gender, age and experience variables. Removed from this research study is the Voluntariness of technology use, “the degree to which use of the innovation is perceived as being voluntary, or of free will” (Moore and Benbasat 1991, 195). This is because focus was on general users who have the freedom to use or not to use their smartphones.

3 Research methodology

For data collection, an online questionnaire survey was developed and posted on surveymonkey.com. The questionnaire consisted of two sections. The first section examined the demographics and background details of participants. The second section sought to ascertain whether respondents used or did not use smartphones. If the respondents currently used smartphones, the questionnaire continued to seek reasons for using smartphones including the question related to the main constructs of the research model.

The research site was northern London, which was selected due to the well-developed mobile coverage infrastructure offered in the vicinity compared to other areas around the UK (Ofcom, 2013). In 2011, North London had a population of 1,880,852 with 474,873 older adults of 50 years old and above in other words, 25.25% of the overall population (OFS, 2011).

A leaflet to the survey location was distributed to 19,760 households. This activity was conducted between December 2013 and January 2014. The link was open for 3.5 months. This resulted in 1,030 completed responses, of which 984 usable responses were from only silver surfers, making a response rate of 5.21%. This low response rate was attributed to the researchers having no control over the selection of the households that consisted of silver surfers.

3.1 Data Analysis

For data analysis, this research applied the Partial Least Square (PLS) technique with the help of SmartPLS version 2.0M3 (Ringle et al., 2005) and Structural Equation Modelling (SEM). SEM is appropriate to explain complicated variable relationships among hierarchical

structural models (Gefen et al., 2000), which is the case in this study. For this study, SEM was used after data cleansing for verification and validation.

4 Research finding

The survey responses revealed 702 respondents had adopted smartphones, 134 respondents planned to have a smartphone and 148 respondents did not plan to have a smartphone. 52.24% of the responses were from males, while 47.76% were from females. In age terms, the majority of the respondents (56%) were from the 50-59 age groups, 34.45% was from the 60-69 age group, 7.52% was from the 70-79 age group, 1.63% was from the 80-89 age group and 0.2% was over 90 years old. In the adopters, the majority (64.10%) was from the 50-59 age groups and 30% was from the 60-69 age group. However, 49.32% of the respondents who did not plan to have a smartphone were from the 60-69 age groups. Moreover, the numbers of respondents in the 60-69 age groups who planned to have smartphones were larger in number than the respondents in the same group who currently use a smartphone device. In employment status terms, 32.83% of the respondents were in full-time employment, 19.61% were pensioners (65+) and 12.60% were self-employed. The retired (over 65 years old) and part-time employed respondents had same percentage of 10.87%. 6.5% of the respondents were unemployed, 3.15% were entrepreneurs, 1.12% were disabled and 0.81% were housewives.

4.1 Uses of the smartphones

As the usage of smartphones was also of interest to this research, a question on smartphone usage was included in the survey. For this variable, 15 questions on smartphone usages were included using a Likert scale measurement ranging from 1-7, where 1 is never and 7 is many times per day.

Usages of a smartphone (Scales range from 1 to 7)	Average	Total (n=702)	
		number	%
1. Making a phone call	4.76	687	97.86
2. SMS, Text messaging	5.19	689	98.15
3. E-mailing	4.19	600	85.47
4. Taking a photo	3.58	647	92.17
5. Filming a video	2.37	454	64.67
6. Browsing-surfing website(s)	4.35	629	89.60
7. Playing games	2.89	420	59.83
8. Watching videos for example YouTube	2.45	426	60.68
9. Mapping, Navigator such as Google Map, Tom-Tom, Copilot	3.21	553	78.77
10. Taking notes such as shopping lists or task that I need to do	2.95	472	67.24
11. Managing my appointment on my calendar	3.52	508	72.36
12. Using social network such as Facebook, Twitter	3.26	440	62.68
13. Reading online News and online Magazines	3.15	482	68.66
14. Using Facetime, Skype, oovoo, Google Talk, Viber, Fring	2.22	322	45.87
15. Using to contact government authorities – NHS, Jobcentreplus, UKBA	1.80	243	34.62

Table 15.1. Smartphone usages

From Table 15.1, it was learnt that people tended to send SMS more frequently than making a phone call. For the advanced features, 89.60% of the respondents indicated that the phone was used for browsing, and 85.47 % used their phone's email facility. Mapping or navigation was used by 78.77% of the respondents with a 3.21 mean frequency. Managing appointments and calendars was used by 72.36% of the respondents with 3.52 mean frequency. 68.66% read online news or magazines with a 3.15 mean frequency. Taking notes, filming a video, using social networks such as Facebook, watching videos and playing games were used by more than half of the users. The frequency of using social media was the highest in this group at 3.26. There was also a question seeking information on Voice over Internet Protocol (VoIP) usage, or video calling applications, such as, Facetime, Skype or Viber, followed by using smartphones to contact government authorities such as NHS or Job centre, with a low frequency of 2.22 and 1.80 respectively.

4.2 Adoption of smartphones

Analysis of the previous findings led to obtaining 27 observed items over 9 latent constructs. After the first analysis, some observed items (SOC4 and FC4) with loading factors below 0.8 were removed.

	Cross-correlations								Item loadings	AVE > 0.50	CR > 0.70	R^2	CA > 0.70
	COM	EE	ENJ	FC	INT	OBS	PE	SOC					
COM	**0.94**								0.92 – 0.95	0.87	0.95		0.93
EE	0.61	**0.97**							0.96 – 0.97	0.93	0.97		0.93
ENJ	0.66	0.65	**0.98**						0.98 – 0.98	0.96	0.98		0.96
FC	0.73	0.66	0.54	**0.86**					0.84 – 0.88	0.74	0.90		0.83
INT	0.77	0.66	0.78	0.66	**0.88**				0.84 – 0.91	0.78	0.91	0.76	0.86
OBS	0.55	0.36	0.33	0.55	0.42	**0.95**			0.95 – 0.95	0.90	0.95		0.90
PE	0.75	0.57	0.61	0.61	0.74	0.43	**0.88**		0.85 – 0.90	0.77	0.91		0.85
SOC	0.53	0.28	0.40	0.40	0.43	0.46	0.51	**0.86**	0.82 – 0.88	0.74	0.89		0.82
									-			0.21	

Table 15.2. Cross-correlations, Item loadings, Average variance Extracted (AVE), Composite Reliability (CR), R-square and Cronbach's Alpha (CA) of the research model. The diagonal elements in bold in the cross-correlations matrix are the square root of AVE

Table 15.2 illustrates the results of reliability and consistency. Composite reliability (CR), which measures the internal consistency, exceeds the 0.7 thresholds for all constructs; thus ensuring their reliability. Next, the items loaded well on their respective factors, exceeding 0.7. Furthermore, all the constructs' AVE was above or almost above 0.5. Finally, according to Fornell and Larcker (1981), when identifying discriminant validity, the square root of AVE

for all the constructs needed to exceed all the other cross-correlations. This criterion was also satisfied for the overall constructs. As such, the model also exhibited satisfactory discriminant validity.

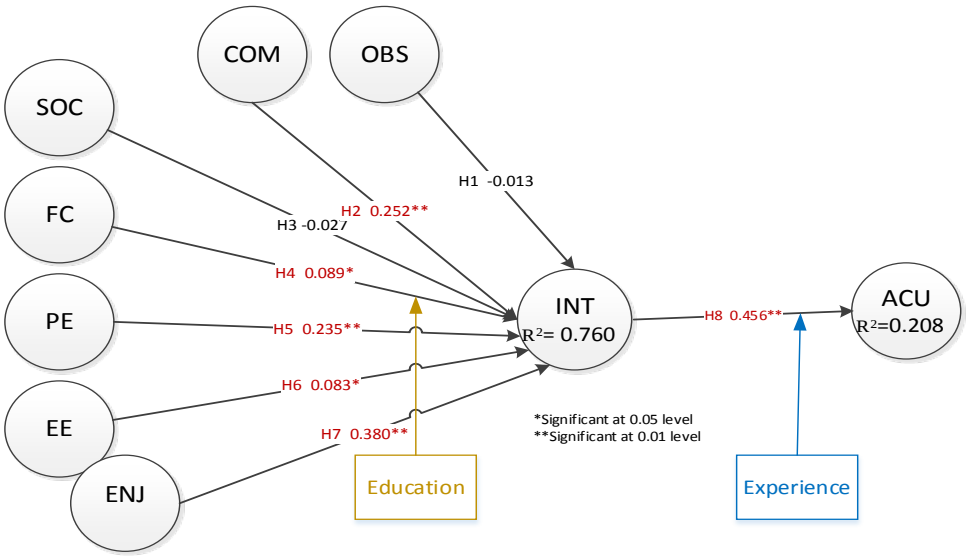

Figure 15.2. Hypothesis Testing Results

Hypothesis	Path coefficients (β)	t-value	Significant (p)	Supported
1. Observability -> Behavioural intention	-0.013	0.480	-	NO
2. Compatibility -> Behavioural intention	0.252	5.116	<0.01	YES
3. Social Influence -> Behavioural intention	-0.027	1.032	-	NO
4. Facilitating -> Behavioural intention	0.089	2.014	<0.05	YES
5. Performance expectancy -> Behavioural intention	0.235	5.765	<0.01	YES
6. Effort Expectancy -> Behavioural intention	0.083	2.511	<0.01	YES
7. Perceived Enjoyment -> Behavioural intention	0.380	10.447	<0.01	YES
8. Behavioural intention -> smartphone usage	0.456	12.490	<0.01	YES

Table 15.3. Hypothesis, Path coefficients, t-value, Significant and hypothesis support

The results from applying SmartPLS are shown in Figure 15.2 and Table 15.3. According to the R-square, the model shows 76.0% of the variance belonged to INT, and 20.8% of the variance to the ACU of smartphones. The path coefficients (β) and t-values from the bootstrap

and PLS algorithm were applied to explain the results. Thus, ENJ (H7) had the strongest factor influence of INT to use smartphones within the silver surfers with β=0.380, t-value= 10.447 and a significant level of (p) < 0.01. COM (H2) and PE (H5) were strong factors, with p < 0.01, β=0.252, t-value= 5.116 and β=0.235, t-value= 5.765 respectively. FC (H4) and EE (H6) were considered significant (p < 0.05) with β=0.089, t-value= 2.014 and β=0.083, t-value= 2.511. Importantly, the INT for the overall sample population appears to have an important effect on ACU (β=0.456, t-value= 12.490 and p< 0.01) However, OBS (H1) and SOC (H3) were considered not significant, with t-value =0.480 and 1.032 respectively. Therefore, of the 8 hypotheses, 6 were supported as shown in Table 15.3.

4.3 Results on adopting smartphones with moderator variables

Also determined were the moderator variables drawn from the original UTAUT in order to gain more understanding of the study's contributions. According to UTAUT, the moderating variables affect relationships between the independent and the dependent variables (Venkatesh et al., 2003). The original moderating variables from UTAUT are gender, age, experience, and voluntariness of use. Experience in this study is defined as the experience of using smartphones. Moreover, since this research is related to older adults, health is selected as a moderator variable. Education is also often used as a moderator variable in technology adoption research (Park et al., 2007). 5 moderators were examined that are gender, age, experience, health, and education (Park et al., 2007). The data was analyzed using the process of Lowry and Gaskin (2014) and a formula provided by Chin (2000). For gender, the dataset was divided into male and female. For age, the dataset was separated between 50-59 and 60-79. User experience was divided to under 2 years and more than 2 years of using smartphones. Health is a self-assessment variable where three choices were available: poor, good and excellent. For moderator analysis, the good and excellent expressions were grouped

against poor. Education levels were Higher Degree, and First Degree against High Diploma, Diploma, A level, and O level. The sub-groups were analyzed using SmartPLS and Chin's (2000) formula to find t-values or significant values. Only the significant results are shown in Table 15.4 and Figure 15.2.

Moderating Model-Experience										
	Less than 2 years (n=238)				More than 2 years (n=464)				Compare	
Hypothesis	β	t-value	Mean	STERR	β	t-value	Mean	STERR	t-value	p-value
INT->ACU	0.525	9.342	0.5232	0.0562	0.352	7.079	0.3502	0.0497	2.159	0.031
Moderating Model-Education										
	Low(n=405)				High(n=282)				Compare	
Hypothesis	β	t-value	Mean	STERR	β	t-value	Mean	STERR	t-value	p-value
FC->INT	0.199	3.687	0.1997	0.054	-0.088	1.320	-0.087	0.0666	3.366	0.001
INT->ACU	0.404	7.923	0.4027	0.051	0.523	9.847	0.5233	0.0531	1.600	0.110

Table 15.4. Significant moderator variables

The results disclosed that education moderated the relationship between FC and INT while Experience moderated the link between INT and ACU at a significant level (p) < 0.01. This was understood as FC having a stronger positive effect on INT for the higher education than the lower education. Similarly, for those who have used smartphones for a long period of time, INT has a stronger positive effect on ACU.

4.4 Smartphone diffusion and communication channels

For diffusion, the questions began by seeking information of the features considered when purchasing smartphones. These questions were asked of both the users and those who plan to use a smartphone in order to investigate the attitudes of these two groups.

Consideration when buying a smartphone	Adapted (n=702)		Plan to use (n=134)		Total	
	Number	(%)	Number	(%)	Number	(%)
1. Appearance (such as color or material)	284	40.46	42	31.34	326	39.00
2. Camera	337	48.01	41	30.60	378	45.22
3. Operating System (such as iOS, Android or Windows Mobile)	397	56.55	48	35.82	445	53.23
4. Brand (such as Apple, Samsung, Nokia or Blackberry)	432	61.54	78	58.21	510	61.00
5. Price	464	66.10	58	43.28	522	62.44
6. Operating Speed	290	41.31	22	16.42	312	37.32
7. Screen Size	452	64.39	47	35.07	499	59.69
8. Screen Resolution	215	30.63	20	14.93	235	28.11
9. Weight	245	34.90	22	16.42	267	31.94
10. Battery life	452	64.39	52	38.81	504	60.29
11. Size of Memory	268	38.18	20	14.93	288	34.45
12. Voice Clarity	171	24.36	21	15.67	192	22.97

Table 15.5. The smartphone features considered when buying

From Table 15.5 above, it was found that those who plan to use a smartphone have less experience with smartphones because they did not own the devices. Within this group, 58.21% was concerned with the brand of the smartphone that they planned to purchase, 43.28% were concerned with the price of the smartphone and 38.81% demonstrated concerns with the battery life. Furthermore, 35.82%, 35.07%, 31.34% and 30.60% were interested in the operating system of the smartphones, screen size, appearance of the phone and camera, respectively. This group was less bothered about speed, screen resolution, weight, sizes of memory, and voice clarity (less than 20%).

Meanwhile, the adopters who had some experience or knowledge displayed diverse interests. They were highly concerned with the price (66.10%), while the screen size and battery life were the second concern (64.39%). Then 61.54% of the adopters were concerned with the brand. Next, 56.55% of this group were interested in the operating system, and 48.01%,

41.31% and 40.46% of the group considered the camera, operating speed and appearance of the phone, respectively. The adopters were less concerned with voice clarity, screen resolution and weight of the smartphones.

It was noted that both groups had diverse views, with those planning to use a smartphone being highly concerned with the brand and the price, while the adopters group was greatly interested in the price, screen sizes and brand. Moreover, from the percentages of both groups, it was noted that after the users had experienced using a smartphone, they were likely to consider more of the smartphone's features.

Where do you get information on a smartphone	**Adopters (n=702)**		**Those planning to use (n=134)**		**Total (n=836)**	
	Number	(%)	Number	(%)	Number	(%)
1. Word of mouth by friends and family	441	62.82	103	76.87	544	65.07
2. High street stores	192	27.35	58	43.28	250	29.90
3. Media (e.g. TV, Radio and Newspapers)	157	22.36	36	26.87	193	23.09
4. Magazines	85	12.11	20	14.93	105	12.56
5. Online social networks	70	9.97	12	8.96	82	9.81
6. Professional technology review website (e.g. CNET.co.uk, Trustedreviews.com)	215	30.63	39	29.10	254	30.38
7. Peer technology review (e.g. unboxing video on YouTube)	66	9.40	8	5.97	74	8.85
8. Sales Person	153	21.79	31	23.13	184	22.01

Table 15.6. Communication channels to get information about smartphones

To determine the communication channel that silver surfers used when adopting or using smartphones, a question relating to communication channels was added. The communication channels included word of mouth by friends and family; high street stores; media, such as TV, radio and newspapers; magazines; online social networks; professional technology review websites; peer technology reviews; and a sales person (shown in Table 15.6). This question was asked of both the adopters and those planning to use. Overall, both groups received smartphone information using the word of mouth from friends and family (65.07%).

However, the group of those planning to use a smartphone (76.87%) relied more on the word of mouth compared to the adopters (62.82%). The professional technology review websites and high street stores followed this at 30.38% and 29.90%, respectively. The channels that both groups utilised less were peer technology reviews, online social networks and magazines. The percentages in both groups were similar except for the group of those planning to use a smartphone, as it was being more reliant on high street stores when compared to the adopters group.

5 Discussion

As shown in Figure 15.2, PE was the strongest factor leading to the adoption of smart phones. This result is similar to a mobile shopping study (Agrebi and Jallais, 2015), mobile application in Finland (Verkasalo et al., 2010) or a study in Canada and France on mobile devices used for surfing the internet (Chtourou and Souiden, 2010). However, the word 'enjoy' or 'fun' is interpreted differently among older adults; that is, the silver surfers did not consider action games as enjoyable, but viewed using their smartphone to capture their moments to share with friends or family as 'enjoyment' or 'fun'. Therefore, smartphone or network providers may need to consider such factors when increasing smartphone adoption. By sharing photographs the smartphone can assist older adults in memory sustainability and also keeping in touch with peers and family. As Addis et al. (2010) found: "older adults remember the good times well, because the brain regions that control the processing of emotions act in concert with those that control the processing of memory, when older adults experience positive events". In terms of academia, these results confirmed that for smartphones adoption, enjoyment is one of the important factors. Therefore, if smartphone providers are seeking increases in smartphones numbers, the enjoyment an older user can gain through the use of the smartphone should be noted.

Facilitating condition, which is one of the main constructs applied in the research was measured using four items (FC1, FC2, FC3 and FC4) in the survey. However, the item FC4, which sought to ascertain whether silver surfers required help from someone when using a smartphone, was removed from the structural model. This was because 26.78% responses suggested very strongly that they did not need help from anyone, implying the majority of the respondents wanted to know more about how to use smartphones, but rarely had someone to assist them. From the questions on EE (H6), smartphones may be considered to be easy to use since the mean in both questions was 5.67 and 5.54, with 1.41 and 1.46 SD. Thus, policy makers, smartphone providers and software developers may need to place an emphasis on providing not only easy to use devices but also easy to understand demonstrations and assistance.

In terms of smartphone usage, the silver surfers' behaviour appeared to suggest that they used only the basic features of a smartphone, such as making a phone call and SMS. However, new features for smartphones, such as emailing and browsing were also used with a high frequency. Some advanced features such as managing appointments on calendars or taking notes were less adopted. Watching videos such as YouTube was not popular within the silver surfers, which this study attributed to the smartphone screen sizes. This issue appeared to be a concern as illustrated by more than half of the responses. In some cases, old people may have physical limitations, such as problems related with the vision or cognition. Therefore, smartphones with large screens may be more compatible with older adults.

For smartphone diffusion, similar to the other age groups, price and branding were the two most concerning factors. Moreover, for those who had smartphone use experience, it appeared that higher expectations of newer versions of smartphones were expected. Another issue highlighted in our study is the issue of the battery life of smartphones. The most important

communication channel appeared to be the ‘word of mouth’ by friends and family, which was closely followed by professional technology reviews that could be used to encourage adoption within computer professionals, such as hardware and software developers, programmers and testers. Simultaneously, sales personnel in high street shops may need to be trained in a diverse manner in order to provide guidance to silver surfers purchasing or using smartphones. Regarding the research model, compatibility (H2) between smartphones and users should be noted. Matters that could be considered are, for example, how smartphones can help or improve an older adult’s lifestyle. The capability (PE, H5), of a smartphone that may be used by older adults needs to be paid attention not only for business matters but also to connect with family and friends, or to take care of their health. However, the phone features and performance should be explained in a very simple way, so that a smartphone will be considered to be an easy to use device (EE, H6)

6 Conclusion

This study examined parameters of adoption of smartphones within UK’s older adult population. To investigate adoption, a research model was developed based on the UTAUT, DoI and PE from TAM 3. From the online survey, this study received 984 complete and usable responses. Of these, 702 respondents had adopted smartphone, 134 respondents planned to have smartphones and 148 did not adopt and did not plan to have smartphones. The results also revealed that 76% of INT construct to use smartphones could be explained in the conceptual framework. Additionally, PE was the strongest factor influencing INT. Significant factors in the conceptual model were PE, COM, FC and EE. Education was a moderating variable in the link between FC and INT, while experience of using smartphones moderated the effect between INT and the ACU of smartphones. However, SOC and OBS were not significant factors in this research. In terms of contributions, this study provides a

research model specifically for 50+ years old adults and their adoption of smartphones. Due to the differences in behaviour and attitudes between younger and older adults, this research provided some examples of the digital divide occurring as a result of ICT's existence. For policy makers, this study offers a view to factors that can encourage smartphones adoption. For the industry, this research offers strengths and weaknesses relating to the adoption of smartphones, which could help promote an increase in sales of smartphones to older adults.

However, this research has some limitations. In applying a quantitative method, this research may not capture additional views apart from the identified factors. Future studies would benefit by verifying the research framework and by seeking to increase the number of respondents. The references in this paper are also limited, as smartphones were introduced in the past few years. This led the team to apply reports from other related fields, such as marketing which are much more up-to-date. For theory, this research focused on adoption theories. Moreover, this research did not distinguish between different user cultures; therefore, the results may only be used as a guideline for difference cultures or geographic areas.

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Appendix 15.1 Factor Loading

Construct Measure	Mean	SD	Construct Measure Definition
Social Influence (SOC1)	4.43	1.95	1. People important to me think I should use a smartphone (For example, friends and family)
Social Influence (SOC2)	3.81	1.95	2. People who influence my behaviour think that I should use a smartphone
Social Influence (SOC3)	4.60	1.88	3. It is expected that people like me will use smartphones (For example, similar age or position people).
Social Influence (SOC4)	3.00	1.90	4. I want to use a smartphone because my friends do so.
Observability (OB1)	5.51	1.64	5. I have had many opportunities to see smartphones being used.
Observability (OB2)	5.39	1.68	6. It is easy for me to observe others using smartphones. (For example, I saw my friends use smartphones)
Compatibility (COM1)	5.91	1.37	7. I believe that using the smartphone is suitable for me.
Compatibility (COM2)	5.61	1.60	8. I believe that using the smartphone will fit my lifestyle.
Compatibility (COM3)	5.59	1.66	9. I think that using the smartphone fits well with my lifestyle or my work.
Facilitating Condition (FC1)	5.79	1.43	10. I have the resources necessary to use the smartphone. (For example, time and money)
Facilitating Condition (FC2)	5.86	1.35	11. I have the knowledge necessary to use the smartphone.

Facilitating Condition (FC3)	5.66	1.51	12. The operation costs of a smartphone do not prevent the use of it (such as, price of a smartphone or monthly fee).
Facilitating Condition (FC4)	3.63	2.20	13. I have a person available to assist me when using my smartphone.
Performance expectancy (PE1)	5.77	1.45	14. I feel a smartphone is useful. (e.g. with my lifestyle, my daily routine and my work)
Performance expectancy (PE2)	4.69	1.92	15. Using a smartphone enables me to finish my personal tasks or work more quickly.
Performance expectancy (PE3)	4.99	1.92	16. Using a smartphone increases my productivity (e.g. to receive or reply emails faster).
Effort Expectancy (EE1)	5.67	1.41	17. I find that using the smartphone is easy.
Effort Expectancy (EE2)	5.54	1.46	18. Learning how to use a smartphone is easy for me.
Enjoyment (ENJ1)	5.37	1.62	19. I think it is fun to use a smartphone.
Enjoyment (ENJ2)	5.20	1.73	20. I find a smartphone fun (I had fun using a smartphone).
Behavioural intention (IN1)	5.28	1.69	21. I intend to use a smartphone as much as possible.
Behavioural intention (IN2)	6.18	1.23	22. I intend to continue using a smartphone in the future.
Behavioural intention (IN3)	5.53	1.61	23. Whenever possible, I intend to use a smartphone in my daily lifestyle or job.
Actual use (ACU)	5.87	1.49	Usage frequency of your smartphone
n=702	The question used likert scale 1-7(1=strongly disagree, 7 =strongly agree)		