Spring 4-10-2019

The Effect of Behavioural Beliefs on Smart Home Technology Adoption

Davit Marikyan
Newcastle University, d.marikyan2@newcastle.ac.uk

Savvas Papagiannidis
Newcastle University, savvas.papagiannidis@newcastle.ac.uk

Eleftherios Alamanos
Newcastle University, Eleftherios.Alamanos@newcastle.ac.uk

The Effect of Behavioural Beliefs on Smart Home Technology Adoption.

Davit Marikyan[a] – d.marikyan2@newcastle.ac.uk

Prof. Savvas Papagiannidis[b] – savvas.papagiannidis@newcastle.ac.uk

Dr. Eleftherios Alamanos[c] – eleftherios.alamanos@newcastle.ac.uk

[abc] Newcastle University Business School, 5 Barrack Road, Newcastle upon Tyne, NE1 4SE, UK

The topic areas:

IS Innovation, Adoption and Diffusion
Human-Computer Interaction
Artificial Intelligence systems
Technologies to Promote a Healthy and Secure Society

The Effect of Behavioural Beliefs on Smart Home Technology Adoption

This cross-sectional study examines the factors affecting smart home technology use in private spaces. Specifically, the role of hedonic and utilitarian beliefs has been examined in the formation of smart technology use behaviour. In addition, this study is aimed at a better understanding of the outcome of smart technology use in terms of individuals' satisfaction, the perception of their well-being and perceived value. A sample of 422 smart home technology users participated in this research by completing an online survey. Structural equational modelling was used to analyse the relationship of the constructs employed with smart home technology use. This exploratory study found a strong effect of the use of smart home technology on subjective wellbeing, satisfaction and perceived value. The findings of this paper contribute to our understanding of smart technology acceptance by highlighting the importance of behavioural beliefs. In addition, they provide empirical evidence of the outcome of the use of smart home products.

Keywords: Technology Acceptance, Smart Home, Behavioural Beliefs, Technology Use Behaviour

1.Introduction

The application of technology beyond the workplace has been gradually increasing year by year. A number of technical devices have been specifically designed for use inside a house (Kapoor, 2004). Household devices have been constantly developing and triggering the growing interest of scholars (Venkatesh, 1996, Brown and Venkatesh, 2005). The latest advances in the information systems literature refer to appliances that aim to make a home a smart one (Chan et al., 2009, Balta-Ozkan et al., 2013a, Marikyan et al., 2019). The term "smart home" can refer to any form of residence which integrates interconnected devices and appliances to fulfil and ease the daily routine tasks (Balta-Ozkan *et al*., 2014). The concept of a house embedded with technology that is capable of bringing health-related, environmental and financial benefits (Balta-Ozkan et al., 2013a, Chan et al., 2009, Demiris and Hensel, 2009, Bhati et al., 2017) has triggered many large technology companies to embark on developing smart home products (Yang *et al*., 2017, Toschi *et al*., 2017). Even though smart home technology is capable of providing significant benefits to users, the realisation of these benefits on a large scale is yet to be seen due to a low acceptance rate (Marikyan et al., 2019). This means there is a need to explore those factors that underline the acceptance of smart homes by users.

Despite emerging tendencies and trends, the literature still has a dearth of research on the acceptance of smart homes. Current research reflects a narrow focus on technology. However, in a broader sense, smart homes represent an intimate and private environment, which is inhabited by multiple actors having different psychological values and beliefs (Choe *et al*., 2011). Consequently, this study aims to contribute to the literature on the acceptance of technology in the context of private spaces, which has been an under-researched area so far. In addition, it will provide an empirical insight into the outcomes of behaviour in terms of satisfaction, subjective well-being and perceived value.

In the following section we will review the literature on smart homes, while in the subsequent section we will introduce the theoretical framework and put forward several hypotheses. The paper then discusses the adopted methodology and presents the results of the analysis. The paper concludes by proposing a number of future research avenues.

2. Literature review.

2.1 Smart Homes

A widely-utilised definition of the smart home has been developed by Aldrich (2003), who defined it as *"a residence equipped with computing and information technology, which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through the management of technology within the home and connections to the world beyond".* The main technical attributes of a smart home are: a) an established communication platform of interconnected devices; b) a degree of artificial intelligence that manages and controls the smart home technology system, c) embedded sensors that collect information, and d) smart attributes (e.g. a smart lighting or heating system), which can automatically respond to the information gathered through sensors (Balta-Ozkan et al., 2013a).

The services that a smart home provides can be categorised into three groups: lifestyle support; energy and consumption management; and safety and security (Balta-Ozkan et al., 2013a, Marikyan et al., 2019). *Lifestyle support* refers to a broad area, embracing such types of activities as communication, entertainment, assisted living, provision of e-health and comfort. The application of smart home technology in daily routines has been shown to improve users' well-being by diminishing the feeling of isolation, as well as promoting independent living for an ageing population (Coughlin *et al*., 2007). *Energy and consumption management* is possible through effective monitoring and the management of energy usage behaviour. Interconnected technologies perform daily routine activities such as house heating, water heating, light management, the search for cheaper energy providers, the termination of energy loads and the regeneration of energy through solar panels. The last group of services is *security and safety,* which can be achieved through an embedded recognition system, remote cameras and motion sensors. The system can perform real-time health diagnostics, it sets reminders for taking medications and even provides the possibility of virtual hospital visits (Ding *et al*., 2011, Chan *et al*., 2009).

The literature lists a significant number of benefits that smart home services are capable of bringing (Balta-Ozkan et al., 2013a, Chan et al., 2009, Demiris and Hensel, 2009). The benefits can be classified into three groups: health-related, environmental and financial ones (Marikyan et al., 2019). The dominant attention of studies is focused on the contribution of technologies to independent living, and the monitoring and management of the occupants' health status (Alaiad and Zhou, 2017). In addition, smart home technologies can diminish the feeling of isolation and improve psychological well-being. This is achieved through the provision of assistance and support in daily routine activities, inducing a feeling of companionship. The attention to long-term *environmental benefits* of a smart home has been facilitated by increasing concern with global warming, climate change and fluctuating energy prices. The assurance in environmental sustainability has drawn upon the ability of smart home technology to reduce energy usage and the carbon footprint. The *financial benefits* of smart home technology are usually connected to environmental and health-related benefits. Users benefit financially from the utilisation of technology for the management of energy and water consumption (Bhati et al., 2017). While environmental sustainability is an ultimate long-term benefit, monetary saving is an immediate outcome. The transformation from traditional health services to home-care can also bring financial benefits in terms of savings of travelling expenses (Marikyan et al., 2019).

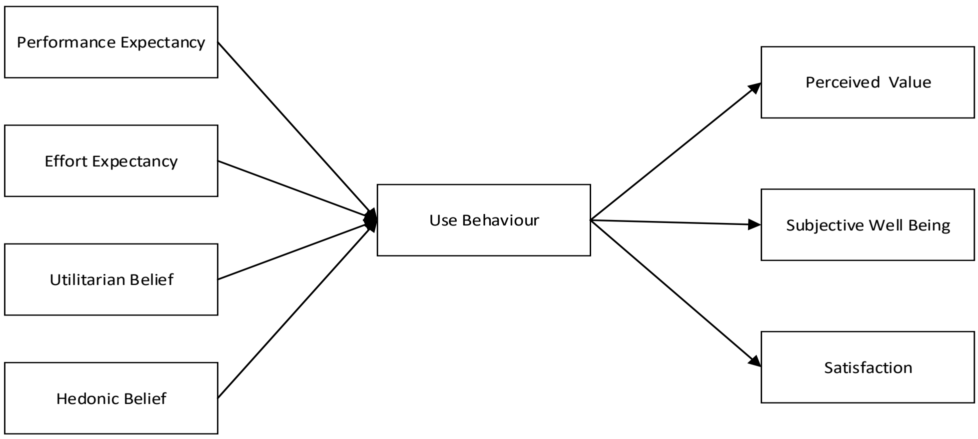
The examination of the perceived beliefs about the behaviour is one of the pillars in IT adoption research. Hence, this study will analyse how behavioural beliefs will affect the use behaviour. The following sections will describe the theoretical foundation of the study and hypotheses.

3. Theoretical Model

This study adopts the Unified Theory of Acceptance and Use of Technology (UTAUT) model developed by Venkatesh et al. (2003) as the starting point for examining the effect of behavioural beliefs on use behaviour. Behavioural belief is an individual's assumption that performing a certain behaviour will lead to anticipated results (Paternoster and Pogarsky, 2009, Bulgurcu et al., 2010, Taneja et al., 2014). UTAUT is considered to be an eclectic theory, combining the well-established predictors in IT adoption research, such as *perceived expectancy*, *effort expectancy, social influence* and *facilitating conditions*. The adoption of the theory as a foundation for the study is justified as it has been widely tested and used in IT adoption research (Dermentzi and Papagiannidis, 2018, Chan et al., 2012, Yoo et al., 2012, Lu et al., 2019, Kim and Shin, 2015). Despite the recognition of the theory by scholars, it has been criticised on two counts. Firstly, UTAUT leaves out important predictors that might explain technology adoption (Bagozzi, 2007). In order to address this critique, this study will incorporate *hedonic* and *utilitarian values*. These two constructs refer to the beliefs about the positive outcomes of behaviour that have been identified through the extensive examination of the literature (Zeithaml, 1988, Babin et al., 1994, Venkatesh et al., 2003). Secondly, some studies provide evidence that the universal effect of *social influence* and *facilitating conditions* on use behaviour is debatable and dependent on contextual factors (Powell et al., 2012, Lian and Yen, 2014, Slade et al., 2015, Renda dos Santos and Okazaki, 2016). In addition, a number of studies have reported no significant effect of facilitating conditions and social influence on use behaviour (Park et al., 2007, Wang and Shih, 2009, Zhou et al., 2010, AlAwadhi and Morris, 2008, Marchewka and Kostiwa, 2007).

Given the above, this study will integrate two UTAUT factors: *performance expectancy* and *effort expectancy*, with *utilitarian* and *hedonic values* to predict the use behaviour. The second part of the model will examine the outcomes of the use behaviour in terms of *satisfaction*, *subjective well-being, social inclusion, perceived value and continuance intention to use*. The detailed discussion of all constructs and hypothetical relations follow.

Figure 1: Research Model



3.1. Behavioural Beliefs

Performance expectancy: Venkatesh *et al*. (2003) introduced and defined performance expectancy "*as the degree to which an individual believes that using the system will help him or her to attain gains in job performance*". The authors developed performance expectancy based on five constructs from established models: extrinsic motivation (MM), a relative advantage (IDT), job-fit (MPCU), outcome expectations (SCT) and perceived usefulness (C-TAM-TPB, TAM and TAM2). The aforementioned constructs share a high degree of similarity (Davis, 1989, Thompson et al., 1991, Compeau and Higgins, 1995). A number of studies argued that the performance expectancy is a significant predictor of an intention and the use of technology (Agarwal and Prasad, 1998, Compeau and Higgins, 1995, Davis et al., 1992, Venkatesh et al., 2012, Al-Gahtani et al., 2007). UTAUT has multiple extensions that have been widely applied in different geographical and cultural settings. The results were consistent with the original findings, confirming the invariant effect of performance expectancy on intention and use behaviour (Al-Gahtani et al., 2007, Wang and Shih, 2009, Venkatesh and Zhang, 2010, AbuShanab and Pearson, 2007). Based on the past literature our first hypothesis is:

Hypothesis 1: *The performance expectancy will have a positive effect on the use behaviour.*

Effort Expectancy: Effort expectancy is defined "*as the degree of ease associated with the use of the system*" (Venkatesh et al., 2003). The authors took three constructs from well-established models: complexity (MPCU), perceived ease of use (TAM/TAM2), and ease of use (IDT). The sub-constructs that form the effort expectancy construct share a high level of similarity and have been found to have a significant impact on intention, both in voluntary and mandatory settings (Davis, 1989, Thompson et al., 1991). These constructs are significant only before an actual use or a trial (Agarwal and Prasad, 1998, Thompson et al., 1991). A number of studies in the technology acceptance field have scrutinised the role of effort expectancy (Venkatesh et al., 2012, Al-Gahtani et al., 2007, Venkatesh and Zhang, 2010, Brown et al., 2010, Martins et al., 2014). They provided evidence that effort expectancy acts as a significant predictor of technology use. Drawing upon the aforementioned research findings, this study hypothesises the following:

Hypothesis 2: *Effort expectancy will have a positive effect on the use behaviour.*

Hedonic and Utilitarian Beliefs: The literature claims that the intention to consume a product is heavily contingent on the hedonic or utilitarian values that drive users towards accepting the technology (Van der Heijden, 2004, Babin et al., 1994). Hedonic belief denotes self-fulfilment value. In the context of information systems, hedonic beliefs can refer to the degree to which the use of a system brings enjoyment and fun (Van der Heijden, 2004, Brown and Venkatesh, 2005). In contrast, utilitarian beliefs are rooted in the idea that the product brings instrumental value, such as increased task performance (Van der Heijden, 2004). Venkatesh and Vitalari (1992) found that users employ information technology in homes to satisfy utilitarian values. For example, smart home technologies can lead to financial savings and support health (Balta-Ozkan et al., 2014, Martin et al., 2008). Van der Heijden (2004) and Chen et al. (2017) also confirmed the dominance of hedonic motives in the acceptance of home technology. Particularly, the employment of smart technologies in the home context is triggered by the stimuli of personal satisfaction, self-education, entertainment and interaction with family and friends (Kraut et al., 1999, Brown and Venkatesh, 2005).

Hypothesis 3*: Users' (a) hedonic beliefs and (b) utilitarian beliefs will have a positive effect on the use behaviour.*

3.2. Outcomes

Satisfaction: An extensive body of research is focused on information technology use and satisfaction (Román et al., 2018, Vlahos and Ferratt, 1995, Calisir and Calisir, 2004). The topic of satisfaction with technology use in the workplace has received extensive research attention (Vlahos and Ferratt, 1995, Elias et al., 2012, Isaac et al., 2017). For instance, employees' use of technology in the workplace is positively related with the efficiency of the decision-making process and operations in an organisation, leading to increased satisfaction (Vlahos and Ferratt, 1995, Román et al., 2018). A number of studies have developed conceptual models to analyse the end-users' satisfaction (Calisir and Calisir, 2004) and scrutinised its antecedents (Mawhinney and Lederer, 1990, Davis et al., 1989). A recent stream of research has investigated the influence of technology use on stress and job satisfaction (Román et al., 2018, Chung et al., 2015, Yueh et al., 2016). Based on the observation of (Vlahos and Ferratt, 1995) , ICT has a significant role in achieving satisfaction, while the relation of use hours and satisfaction was found to be insignificant. The study also indicated that the satisfaction level is not consistent among employees. A number of other researchers have argued that the use of technology in the workplace can cause stress and dissatisfaction among employees (Ahearne et al., 2005, Sundaram et al., 2007, Tarafdar et al., 2014). This finding has been confirmed in a different context. For example, the research on the use of technology in higher education suggested that intensive use results in anxiety, which negatively affects satisfaction (Lepp et al., 2014). However, drawing on observations by (Duxbury et al., 2014), the utilisation of technology in the workplace makes it possible to ease the job-related stress of employees. A recent study by Román et al. (2018) confirmed the findings reported by Duxbury et al. (2014). The conflicting results can be linked to such factors as the availability of training on the use of technology and the technology's complexity. This assumption signals the need to examine the effect of technology use on satisfaction by controlling other predictors of technology use. Based on the aforementioned discussion, we hypothesise that:

Hypothesis 4: *The use of smart home technologies will have a positive effect on a user's satisfaction.*

Subjective Well-being: Subjective well-being (SWB) is defined by researchers as an individual's emotional reactions to events and is assessed by the opinions they hold about their life satisfaction and fulfilment. The phenomenon of SWB can be examined against the present and long-term periods (Diener *et al*., 2003). For example, El Hedhli *et al*. (2013) reported the positive effect of shopping on an individual's well-being. In addition, many studies have questioned the causal effect of information system technology acceptance on users' wellbeing and demonstrated the significance of the relationship of the two variables (Sum et al., 2008, Subrahmanyam and Lin, 2007). One of the recent studies by Hill *et al*. (2015) found that the use of technology in everyday life is positively associated with subjective well-being. Users recognised the empowering role of technology and its effect on relationships in society as well as its value for daily activities (Hill *et al*., 2015). Based on the aforementioned research studies, we hypothesise that:

Hypothesis 5: *The use of smart home technologies will have a direct positive effect on subjective well-being.*

Perceived Value: People differ significantly in the way in which the value of a product can be perceived. Zeithaml (1988) defined perceived value as a *"consumer's overall assessment of the utility of a product (or service) based on perceptions of what is received and what is given"*. The definition derived from the idea that an individual evaluated and compared the "give" and "get" components of the selected service or product. Perceived value can be conceptualised as value for money, meaning a simple trade-off between quality and price (Cravens et al., 1988, Monroe and Rao, 1987). However, a number of studies have provided empirical evidence supporting the suggestion that this conceptualisation is too simplistic (Schechter, 1984, Bolton and Drew, 1991). For instance, (Porter, 1990) sees perceived value as a construct encompassing a number of dimensions, such as after-sales service, functionality and quality. In the IS literature, perceived value can take a very generic form, reflecting any of the social (e.g. social influence or subjective norms), hedonic (e.g. perceived enjoyment, fun or entertainment) or utilitarian benefits. For example, a recent study has examined perceived value in the extended technology acceptance model (Lu et al., 2019). This study found a significant relationship between continuance intention to use and perceived value. The findings replicated the results of the studies by (Partala and Saari, 2015) and (Kim et al., 2008). Similarly, there is a high correlation between perceived value and purchase intention (Ponte et al., 2015). In line with the above-mentioned studies highlighting the importance of perceived value in technology use and the acceptance context, we aim to explore the effect of smart home use behaviour on perceived value.

Hypothesis 6: *The use of smart home technologies will have a direct positive effect on perceived value.*

4. Methodology

4.1 Data collection and sampling

This study adopted a quantitative approach. Before distributing the questionnaire to consumers, we conducted a pilot study. The data was gathered online by employing a consumer panel in the United States. The recruitment of the panel members was organised by an independent research company. 510 passed a screening question and were included in the final sample. The purpose of incorporating the screening question was to focus only on respondents who used or had used smart home technology in the past. The final sample that was used in this analysis consisted of 422 completed questionnaires (Table 1).

Table 1: Demographic characteristics

Attribute	Type	Frequency (n=422)	Percentages (%)
Gender	Male	195	46.20%
	Female	227	53.80%
Age	20-29	29	6.90%
	30-39	50	11.80%
	40-49	67	15.90%
	50-59	96	22.70%
	60-69	170	40.30%
	70-79	10	2.40%
Employment	Full time employed	183	43.40%
	Part time employed	46	10.90%
	Out of Work (but looking for)	12	2.80%
	Out of Work (but not looking for)	3	0.70%
	Homemaker	39	9.20%
	Student	7	1.70%
	Retired	111	26.30%
	Unable to Work	21	5%
Ethnicity	Non-Hispanic White or Euro-American	352	83.40%
	Black, Afro-Caribbean, or African American	32	7.60%
	Latino or Hispanic American	19	4.50%
	East Asian or Asian American	8	1.90%
	South Asian or Indian American	4	0.90%
	Native American or Alaskan Native	2	0.50%
	Mixed	3	0.70%
	Other	2	0.50%
Education	Some high school or less	3	0.70%
	High school graduate or equivalent	75	17.80%
	Vocational/technical school (two-year program)	49	11.60%
	Some college, but no degree	100	23.70%
	College graduate (four-year program)	113	26.80%
	Some graduate school, but not degree	9	2.10%
	Graduate degree (MSc, MBA, PhD, etc.)	67	15.90%
	Professional degree (M.D., J.D., etc.)	6	1.40%
Geographical location	Urbanized Area (50,000 or more people)	175	41.50%
	Urban Cluster (at least 2,500 and less than 50,000)	128	30.30%
	Rural (all other areas)	119	28.20%
Household Income	$0-$24,999	58	13.70%
	$25,000-$49,999	115	27.30%
	$50,000-$74,999	110	26.10%
	$75,000-$99,999	68	16.10%
	More than $100,000	71	16.80%
Marital Status	Single (never married)	101	23.90%

	Married	252	59.70%
	Separated	2	0.50%
	Widowed	15	3.60%
	Divorced	52	12.30%

4.2 Measurement items

The questionnaire encompassed 30 measurements (Table 2). Items were measured employing a seven-point Likert scale. Respondents had an opportunity to express their choice by selecting one of the seven options provided (strongly disagree; disagree; somewhat disagree; neither agree nor disagree; somewhat agree; agree; strongly agree). This approach is considered to be an effective way to measure latent variables (Churchill, 2002). Performance expectancy and effort expectancy are constructs taken from UTAUT (Venkatesh et al., 2003). Items to measure hedonic and utilitarian beliefs were adopted from the paper by Babin et al. (1994), whereas items to assess individuals' subjective well-being were adopted from the study by (Diener et al., 2010). The scale used by Ajzen and Fishbein (1980), Taylor and Todd (1995b), Riemenschneider and McKinney (2002), Huang and Chuang (2007) was adopted to examine respondents' smart home use behaviour. The satisfaction scale derived from the study by (Spreng and Mackoy, 1996). Finally, the scale created by Dodds et al. (1991) was employed to measure the perceived value of smart home technology use.

Table 2: Measurement Items

Measurement Item	Loading	C.R.	AVE	Cronbach's α
Performance Expectancy (Venkatesh et al., 2003, Venkatesh and Morris, 2000)		0.966	0.875	0.965
I would find smart technologies useful in my daily life	0.936			
Using smart technologies enables me to accomplish tasks more quickly	0.958			
Using smart technologies increases my productivity in the house	0.946			
If I use smart technologies, I increase my chances of achieving things that are important to me	0.901			
Effort Expectancy (Venkatesh et al., 2003, Venkatesh and Morris, 2000)		0.963	0.867	0.962
My interaction with smart technologies is clear and understandable	0.888			
It is easy for me to become skilful at using smart technologies	0.932			
I find smart technologies easy to use	0.95			
Learning to operate smart technologies is easy for me	0.954			
Hedonic Beliefs (Babin et al., 1994)		0.973	0.879	0.973
Compared to other things I could have done, the time I spend using smart technologies is truly enjoyable	0.933			
I enjoy being immersed in exciting new smart products	0.946			
I enjoy the use of smart technologies for its own sake, not just for the services that they provide	0.921			
I have a good time using smart technologies, because I am able to act on the "spur-of-the-moment"	0.946			
During the use of smart technologies, I feel the excitement	0.942			
Utilitarian Beliefs (Babin et al., 1994)		0.95	0.863	0.949
I accomplish just what I want when using smart technologies	0.949			
I can achieve what I really need when using smart technologies	0.951			
When using smart technologies, I find just the services I am looking for	0.886			
Subjective Well Being (Diener et al., 2003, Diener et al., 2010)		0.965	0.82	0.965

Using smart technology makes it possible to ... - lead a purposeful and meaningful life	0.873			
Using smart technology makes it possible to ... - feel that my social relationships are supportive	0.915			
Using smart technology makes it possible to ... - feel that I am engaged in my daily activities	0.943			
Using smart technology makes it possible to ... - feel that I can contribute to the well-being of others	0.935			
Using smart technology makes it possible to ... - feel that I am competent	0.876			
Using smart technology makes it possible to ... - feel optimistic	0.89			
Use Behaviour (Ajzen and Fishbein, 1980, Taylor and Todd, 1995a, Taylor and Todd, 1995b, Riemenschneider and McKinney, 2002, Huang and Chuang, 2007)		0.885	0.795	0.881
I could communicate to others the consequence of using smart technologies	0.837			
The results of using smart technologies are apparent to me	0.943			
Satisfaction (Spreng and Mackoy, 1996)		0.952	0.832	0.951
How satisfied are you with your overall experience with smart technology?	0.906			
How much pleasure do you get from your overall experience with smart technology?	0.946			
Given your overall experience with smart technologies, do you get frustrated or contented?	0.861			
Given your overall experience with smart technologies, do you feel terrible or delighted by them?	0.934			
Perceived Value (Dodds et al., 1991)		0.874	0.776	0.871
Smart technologies are considered to be a very good buy	0.922			
Smart technologies appear to be a good bargain	0.838			

Note: 7-point Likert scale was employed to measure the items: Model fit: $X^{2(377)}$ = 807.8, CMIN/DF= 2.143, CFI = .976, RMSEA = .052

4.3 Data Analysis

Our data analysis strategy was based on the guidelines provided by (Hair Jr and Lukas, 2014) and by (Gaskin, 2016). To examine the proposed hypotheses, we used SPSS v.24 and SPSS AMOS v. 24 statistical software tools. The first step was to run confirmatory factor analysis to assess construct validity and reliability. CFA suggested a satisfactory model fit (table 2). The reliability of each measured variable was satisfactory (Hair Jr and Lukas, 2014), including the factor loading (>0.8), construct reliability (C.R. >0.8), average variance expected (AVE > 0.7) and Cronbach's α (>0.8). Analysis showed no validity concerns (table 3).

Table 3: Convergent Validity

	1	2	3	4	5	6	7	8
Hedonic Beliefs	0.938							
Performance Expectancy	0.862	0.935						
Effort Expectancy	0.797	0.814	0.931					
Utilitarian Beliefs	0.901	0.845	0.786	0.929				
Perceived Value	0.827	0.759	0.655	0.845	0.881			
Satisfaction	0.786	0.742	0.718	0.808	0.79	0.912		
Use Behaviour	0.76	0.734	0.784	0.79	0.694	0.732	0.892	
Subjective Well being	0.793	0.729	0.59	0.74	0.766	0.745	0.602	0.906

5. Findings & Discussion

The proposed model was in line with the required model fit criteria (table 4). All hypotheses were supported except for H1. We analysed the effect of the antecedents examined, such as performance expectancy and effort expectancy on the effect on use behaviour. The IS literature, specifically in the area of technology acceptance and adoption, reported a positive effect of UTAUT constructs on technology use (Venkatesh et al., 2003, Wang et al., 2009, Teo, 2011). Our analysis revealed a weak effect of effort expectance on use behaviour and performance expectancy was not statistically significant. Therefore H1 was not supported and H2 was partially supported. This result can be interpreted on the grounds that our sample consisted of individuals who had used smart home technology in the past (Mathieson, 1991, Im et al., 2011). Both hedonic and utilitarian beliefs were statistically significant at the < 0.001 level and had a medium to strong effect on individuals' use behaviour. This finding supported our hypotheses H3a and H3b and it was consistent with the evidence in the literature that hedonic and utilitarian beliefs affect behaviour and purchase intention. The literature claims that the intention to consume a product is heavily contingent on the hedonic or utilitarian values that drive users towards accepting the technology (Van der Heijden, 2004, Babin et al., 1994).

The second focus of this study was to test relevant outcomes of smart home technology use. The analysis revealed that smart home use has a statistically significant and a strong effect on subjective well-being, satisfaction and perceived value. Accordingly, H4-H6 were supported with significance at the < 0.001 level. These strong relationships explain the benefits that smart home technologies are capable of realising (Balta-Ozkan et al., 2014, Balta-Ozkan et al., 2013a, Balta-Ozkan et al., 2013b, Marikyan et al., 2019). The statistically significant and strong effect of the use behaviour on subjective wellbeing is in line with the viewpoint of (Demiris and Hensel, 2008). The aforementioned study stated that using smart home technologies might increase the overall wellbeing of the residents. However, the current study was the first to confirm this empirically. In addition to the viewpoint of Balta-Ozkan et al. (2013a) and Aldrich (2003), this study empirically confirmed that individuals gain satisfaction and perceived value, which can be interpreted in terms of the financial, environmental and health-related benefits that smart home technology use brings.

Table4: The results of hypothesis testing: SEM (H1-7): Model Fit X2 (392) = 1082.725, CMIN/DF = 2.762, CFI = 0.961, RMSEA = 0.065

Hypotheses	Standardised Path Coefficient	t-values	R^2
H1: Performance Expectancy --> Use Behaviour	0.095	1.731$^{(ns)}$	0.909
H2: Effort Expectancy --> Use Behaviour	0.111	2.504$^{(**)}$	
H3a: Hedonic Beliefs --> Use Behaviour	0.337	4.933$^{(***)}$	
H3b: Utilitarian Beliefs --> Use Behaviour	0.459	6.776$^{(***)}$	
H4: Use Behaviour --> Satisfaction	0.873	16.079$^{(***)}$	0.762
H5: Use Behaviour --> Subjective Well Being	0.810	14.698$^{(***)}$	0.657
H6: Use Behaviour --> Perceived Value	0.881	14.74(***)	0.777

Conclusion and Future Research Avenues

There is a dearth of empirical studies that examine users' perspectives on smart home technologies as a pervasive technology in private spaces (Chan et al., 2008, Marikyan et al., 2019). Given the identified gap, this study aimed to examine the factors influencing smart home use behaviour and outcomes of smart home technology use. First, this study contributes to the smart home literature and technology acceptance literature. The main contribution is in understanding the effect of smart home usage on people's life. This study found that smart home usage has a statistically significant and strong effect on perceived value, subjective wellbeing and satisfaction. The second contribution was testing whether behavioural beliefs, such as hedonic and utilitarian beliefs, had a statistically significant effect on acceptance of pervasive technology in private space.

This study is not without limitations. First, smart home technology users were located in the United States. A study developed by Balta-Ozkan et al. (2013b) revealed that consumers' perceptions of smart home technology differ in the United Kingdom, Germany and Italy. In addition, cultural differences and the advancement level of the information system infrastructure might affect individuals' perception and acceptance of technology (Al-Gahtani et al., 2007, Straub et al., 1997, Sunny et al., 2018). Therefore it may be important to test the smart home use behaviour model by employing a sample from other countries. In addition, the proposed model can be extended by applying moderating effects, such as personality traits, to examine their effect on the relationship of the use behaviour and behavioural outcomes. Lastly, drawing upon the smart home literature (Martin et al., 2008, Chan et al., 2009, Marikyan et al., 2019) there is a need to identify factors that can hinder the acceptance of smart home technology.

Refence List

ABUSHANAB, E. & PEARSON, J. 2007. Internet banking in Jordan: The unified theory of acceptance and use of technology (UTAUT) perspective. *Journal of Systems and information Technology,* 9**,** 78-97.
AGARWAL, R. & PRASAD, J. 1998. A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information systems research,* 9**,** 204-215.
AHEARNE, M., JELINEK, R. & RAPP, A. 2005. Moving beyond the direct effect of SFA adoption on salesperson performance: Training and support as key moderating factors. *Industrial Marketing Management,* 34**,** 379-388.
AJZEN, I. & FISHBEIN, M. 1980. *Understanding Attitudes and Predicting Social Behavior*.
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**,** 681-691.
ALAIAD, A. & ZHOU, L. 2017. Patients' Adoption of WSN-Based Smart Home Healthcare Systems: An Integrated Model of Facilitators and Barriers. *IEEE Transactions on Professional Communication,* 60**,** 4-23.
ALAWADHI, S. & MORRIS, A. The Use of the UTAUT Model in the Adoption of E-government Services in Kuwait. Hawaii International Conference on System Sciences, Proceedings of the 41st Annual, 2008. Ieee, 219-219.
ALDRICH, F. K. 2003. Smart homes: Past, present and future. *Inside the Smart Home***,** 17-39.
BABIN, B. J., DARDEN, W. R. & GRIFFIN, M. 1994. Work and/or fun: measuring hedonic and utilitarian shopping value. *Journal of consumer research,* 20**,** 644-656.
BAGOZZI, R. P. 2007. The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the association for information systems,* 8**,** 3.
BALTA-OZKAN, N., AMERIGHI, O. & BOTELER, B. 2014. A comparison of consumer perceptions towards smart homes in the UK, Germany and Italy: reflections for policy and future research. *Technology Analysis & Strategic Management,* 26**,** 1176-1195.
BALTA-OZKAN, N., DAVIDSON, R., BICKET, M. & WHITMARSH, L. 2013a. The development of smart homes market in the UK. *Energy,* 60**,** 361-372.
BALTA-OZKAN, N., DAVIDSON, R., BICKET, M. & WHITMARSH, L. 2013b. Social barriers to the adoption of smart homes. *Energy Policy,* 63**,** 363-374.
BHATI, A., HANSEN, M. & CHAN, C. M. 2017. Energy conservation through smart homes in a smart city: A lesson for Singapore households. *Energy Policy,* 104**,** 230-239.
BOLTON, R. N. & DREW, J. H. 1991. A multistage model of customers' assessments of service quality and value. *Journal of Consumer Research,* 17**,** 375-384.
BROWN, S. A., DENNIS, A. R. & VENKATESH, V. 2010. Predicting collaboration technology use: Integrating technology adoption and collaboration research. *Journal of Management Information Systems,* 27**,** 9-54.
BROWN, S. A. & VENKATESH, V. 2005. Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle. *MIS quarterly***,** 399-426.
BULGURCU, B., CAVUSOGLU, H. & BENBASAT, I. 2010. Information security policy compliance: an empirical study of rationality-based beliefs and information security awareness. *MIS quarterly,* 34**,** 523-548.
CALISIR, F. & CALISIR, F. 2004. The relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end-user satisfaction with enterprise resource planning (ERP) systems. *Computers in human behavior,* 20**,** 505-515.
CHAN, F. T., CHONG, A. Y.-L. & ZHOU, L. 2012. An empirical investigation of factors affecting e-collaboration diffusion in SMEs. *International Journal of Production Economics,* 138**,** 329-344.
CHAN, M., CAMPO, E., ESTÈVE, D. & FOURNIOLS, J.-Y. 2009. Smart homes — Current features and future perspectives. *Maturitas,* 64**,** 90-97.

CHAN, M., ESTÈVE, D., ESCRIBA, C. & CAMPO, E. 2008. A review of smart homes—Present state and future challenges. *Computer Methods and Programs in Biomedicine,* 91**,** 55-81.

CHEN, S., LIU, T., GAO, F., JI, J., XU, Z., QIAN, B., WU, H. & GUAN, X. 2017. Butler, Not Servant: A Human-Centric Smart Home Energy Management System. *IEEE Communications Magazine,* 55**,** 27-33.

CHOE, E. K., CONSOLVO, S., JUNG, J., HARRISON, B. & KIENTZ, J. A. Living in a glass house: a survey of private moments in the home. Proceedings of the 13th international conference on Ubiquitous computing, 2011. ACM, 41-44.

CHUNG, S., LEE, K. Y. & CHOI, J. 2015. Exploring digital creativity in the workspace: The role of enterprise mobile applications on perceived job performance and creativity. *Computers in Human Behavior,* 42**,** 93-109.

CHURCHILL, G. A. 2002. & Iacobucci, D.(2002). *Marketing Research-Methodological Foundations***,** 14.

COMPEAU, D. R. & HIGGINS, C. A. 1995. Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly: Management Information Systems,* 19**,** 189-210.

COUGHLIN, J., D'AMBROSIO, L. A., REIMER, B. & PRATT, M. R. 2007. Older adult perceptions of smart home technologies: implications for research, policy & market innovations in healthcare. *Conf Proc IEEE Eng Med Biol Soc,* 2007**,** 1810-5.

CRAVENS, D. W., HOLLAND, C. W., LAMB JR, C. W. & MONCRIEF III, W. C. 1988. Marketing's role in product and service quality. *Industrial Marketing Management,* 17**,** 285-304.

DAVIS, F. D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems,* 13**,** 319-339.

DAVIS, F. D., BAGOZZI, R. P. & WARSHAW, P. R. 1989. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science,* 35**,** 982-1003.

DAVIS, F. D., BAGOZZI, R. P. & WARSHAW, P. R. 1992. Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of applied social psychology,* 22**,** 1111-1132.

DEMIRIS, G. & HENSEL, B. 2009. "Smart Homes" for Patients at the End of Life. *Journal of Housing for the Elderly,* 23**,** 106-115.

DEMIRIS, G. & HENSEL, B. K. 2008. Technologies for an aging society: a systematic review of "smart home" applications. *Yearb Med Inform***,** 33-40.

DERMENTZI, E. & PAPAGIANNIDIS, S. 2018. UK public's intention to engage with academia via online technologies. *Behaviour & Information Technology,* 37**,** 120-132.

DIENER, E., OISHI, S. & LUCAS, R. E. 2003. Personality, culture, and subjective well-being: Emotional and cognitive evaluations of life. *Annual review of psychology,* 54**,** 403-425.

DIENER, E., WIRTZ, D., TOV, W., KIM-PRIETO, C., CHOI, D.-W., OISHI, S. & BISWAS-DIENER, R. 2010. New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research,* 97**,** 143-156.

DING, D., COOPER, R. A., PASQUINA, P. F. & FICI-PASQUINA, L. 2011. Sensor technology for smart homes. *Maturitas,* 69**,** 131-136.

DODDS, W. B., MONROE, K. B. & GREWAL, D. 1991. Effects of price, brand, and store information on buyers' product evaluations. *Journal of marketing research***,** 307-319.

DUXBURY, L., HIGGINS, C., SMART, R. & STEVENSON, M. 2014. Mobile technology and boundary permeability. *British Journal of Management,* 25**,** 570-588.

EL HEDHLI, K., CHEBAT, J.-C. & SIRGY, M. J. 2013. Shopping well-being at the mall: Construct, antecedents, and consequences. *Journal of Business Research,* 66**,** 856-863.

ELIAS, S. M., SMITH, W. L. & BARNEY, C. E. 2012. Age as a moderator of attitude towards technology in the workplace: work motivation and overall job satisfaction. *Behaviour & Information Technology,* 31**,** 453-467.

GASKIN, J. 2016. Excel StatTools. Stats tools package.

HAIR JR, J. F. & LUKAS, B. 2014. *Marketing research*, McGraw-Hill Education Australia.

HILL, R., BETTS, L. R. & GARDNER, S. E. 2015. Older adults' experiences and perceptions of digital technology:(Dis) empowerment, wellbeing, and inclusion. *Computers in Human Behavior,* 48**,** 415-423.
HUANG, E. & CHUANG, M. H. 2007. Extending the theory of planned behaviour as a model to explain post-merger employee behaviour of IS use. *Computers in Human Behavior,* 23**,** 240-257.
IM, I., HONG, S. & KANG, M. S. 2011. An international comparison of technology adoption: Testing the UTAUT model. *Information & management,* 48**,** 1-8.
ISAAC, O., ABDULLAH, Z., RAMAYAH, T. & MUTAHAR, A. M. 2017. Internet usage, user satisfaction, task-technology fit, and performance impact among public sector employees in Yemen. *The International Journal of Information and Learning Technology,* 34**,** 210-241.
KAPOOR, A. 2004. The digital home: The futuristic foyer. *Microsoft® Home Magazine*.
KIM, K. J. & SHIN, D. H. 2015. An acceptance model for smart watches: Implications for the adoption of future wearable technology. *Internet Research,* 25**,** 527-541.
KIM, T. G., LEE, J. H. & LAW, R. 2008. An empirical examination of the acceptance behaviour of hotel front office systems: An extended technology acceptance model. *Tourism management,* 29**,** 500-513.
KRAUT, R., MUKHOPADHYAY, T., SZCZYPULA, J., KIESLER, S. & SCHERLIS, B. 1999. Information and communication: Alternative uses of the Internet in households. *Information Systems Research,* 10**,** 287-303.
LEPP, A., BARKLEY, J. E. & KARPINSKI, A. C. 2014. The relationship between cell phone use, academic performance, anxiety, and satisfaction with life in college students. *Computers in Human Behavior,* 31**,** 343-350.
LIAN, J.-W. & YEN, D. C. 2014. Online shopping drivers and barriers for older adults: Age and gender differences. *Computers in Human Behavior,* 37**,** 133-143.
LU, Y., PAPAGIANNIDIS, S. & ALAMANOS, E. 2019. Exploring the emotional antecedents and outcomes of technology acceptance. *Computers in Human Behavior,* 90**,** 153-169.
MARCHEWKA, J. T. & KOSTIWA, K. 2007. An application of the UTAUT model for understanding student perceptions using course management software. *Communications of the IIMA,* 7**,** 10.
MARIKYAN, D., PAPAGIANNIDIS, S. & ALAMANOS, E. 2019. A systematic review of the smart home literature: A user perspective. *Technological Forecasting and Social Change,* 138**,** 139-154.
MARTIN, S., KELLY, G., KERNOHAN, W. G., MCCREIGHT, B. & NUGENT, C. 2008. Smart home technologies for health and social care support. *Cochrane Database Syst Rev***,** CD006412.
MARTINS, C., OLIVEIRA, T. & POPOVIČ, A. 2014. Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application. *International Journal of Information Management,* 34**,** 1-13.
MATHIESON, K. 1991. Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information systems research,* 2**,** 173-191.
MAWHINNEY, C. H. & LEDERER, A. L. 1990. A study of personal computer utilization by managers. *Information & Management,* 18**,** 243-253.
MONROE, K. B. & RAO, A. R. Testing the relationship between price, perceived quality and perceived value. annual conference of the Association for Consumer Research, October, Cambridge, MA, 1987.
PARK, J., YANG, S. & LEHTO, X. 2007. Adoption of mobile technologies for Chinese consumers. *Journal of Electronic Commerce Research,* 8.
PARTALA, T. & SAARI, T. 2015. Understanding the most influential user experiences in successful and unsuccessful technology adoptions. *Computers in Human Behavior,* 53**,** 381-395.
PATERNOSTER, R. & POGARSKY, G. 2009. Rational choice, agency and thoughtfully reflective decision making: The short and long-term consequences of making good choices. *Journal of Quantitative Criminology,* 25**,** 103-127.

PONTE, E. B., CARVAJAL-TRUJILLO, E. & ESCOBAR-RODRÍGUEZ, T. 2015. Influence of trust and perceived value on the intention to purchase travel online: Integrating the effects of assurance on trust antecedents. *Tourism Management,* 47**,** 286-302.
PORTER, M. E. 1990. The competitive advantage of nations. *Competitive Intelligence Review,* 1**,** 14-14.
POWELL, A., WILLIAMS, C. K., BOCK, D. B., DOELLMAN, T. & ALLEN, J. 2012. e-Voting intent: A comparison of young and elderly voters. *Government Information Quarterly,* 29**,** 361-372.
RENDA DOS SANTOS, L. M. & OKAZAKI, S. 2016. Planned e-learning adoption and occupational socialisation in Brazilian higher education. *Studies in Higher Education,* 41**,** 1974-1994.
RIEMENSCHNEIDER, C. K. & MCKINNEY, V. R. 2002. Assessing belief differences in small business adopters and non-adopters of web-based e-commerce. *Journal of Computer Information Systems,* 42**,** 101-107.
ROMÁN, S., RODRÍGUEZ, R. & JARAMILLO, J. F. 2018. Are mobile devices a blessing or a curse? Effects of mobile technology use on salesperson role stress and job satisfaction. *Journal of Business & Industrial Marketing,* 33**,** 651-664.
SCHECHTER, L. 1984. A normative conception of value. *Progressive Grocer, executive report,* 2**,** 12-14.
SLADE, E., WILLIAMS, M., DWIVEDI, Y. & PIERCY, N. 2015. Exploring consumer adoption of proximity mobile payments. *Journal of Strategic Marketing,* 23**,** 209-223.
SPRENG, R. A. & MACKOY, R. D. 1996. An empirical examination of a model of perceived service quality and satisfaction. *Journal of retailing,* 72**,** 201-214.
STRAUB, D., KEIL, M. & BRENNER, W. 1997. Testing the technology acceptance model across cultures: A three country study. *Information & management,* 33**,** 1-11.
SUBRAHMANYAM, K. & LIN, G. 2007. Adolescents on the net: Internet use and well-being. *Adolescence,* 42**,** 659.
SUM, S., MATHEWS, R. M., HUGHES, I. & CAMPBELL, A. 2008. Internet use and loneliness in older adults. *CyberPsychology & Behavior,* 11**,** 208-211.
SUNDARAM, S., SCHWARZ, A., JONES, E. & CHIN, W. W. 2007. Technology use on the front line: how information technology enhances individual performance. *Journal of the Academy of Marketing Science,* 35**,** 101-112.
SUNNY, S., PATRICK, L. & ROB, L. 2018. Impact of cultural values on technology acceptance and technology readiness. *International Journal of Hospitality Management*.
TANEJA, A., VITRANO, J. & GENGO, N. J. 2014. Rationality-based beliefs affecting individual’s attitude and intention to use privacy controls on Facebook: An empirical investigation. *Computers in Human Behavior,* 38**,** 159-173.
TARAFDAR, M., BOLMAN PULLINS, E. & RAGU-NATHAN, T. 2014. Examining impacts of technostress on the professional salesperson's behavioural performance. *Journal of Personal Selling & Sales Management,* 34**,** 51-69.
TAYLOR, S. & TODD, P. 1995a. Assessing IT usage: The role of prior experience. *MIS quarterly***,** 561-570.
TAYLOR, S. & TODD, P. A. 1995b. Understanding information technology usage: A test of competing models. *Information systems research,* 6**,** 144-176.
TEO, T. 2011. Factors influencing teachers’ intention to use technology: Model development and test. *Computers & Education,* 57**,** 2432-2440.
THOMPSON, R. L., HIGGINS, C. A. & HOWELL, J. M. 1991. Personal computing: toward a conceptual model of utilization. *MIS quarterly***,** 125-143.
TOSCHI, G. M., CAMPOS, L. B. & CUGNASCA, C. E. 2017. Home automation networks: A survey. *Computer Standards & Interfaces,* 50**,** 42-54.
VAN DER HEIJDEN, H. 2004. User acceptance of hedonic information systems. *MIS quarterly***,** 695-704.

VENKATESH, A. 1996. Computers and other interactive technologies for the home. *Communications of the ACM,* 39**,** 47-54.
VENKATESH, A. & VITALARI, N. P. 1992. An emerging distributed work arrangement: An investigation of computer-based supplemental work at home. *Management Science,* 38**,** 1687-1706.
VENKATESH, V. & MORRIS, M. G. 2000. Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS quarterly***,** 115-139.
VENKATESH, V., MORRIS, M. G., DAVIS, G. B. & DAVIS, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems,* 27**,** 425-478.
VENKATESH, V., THONG, J. Y. & XU, X. 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly***,** 157-178.
VENKATESH, V. & ZHANG, X. 2010. Unified theory of acceptance and use of technology: US vs. China. *Journal of global information technology management,* 13**,** 5-27.
VLAHOS, G. E. & FERRATT, T. W. 1995. Information technology use by managers in Greece to support decision making: amount, perceived value, and satisfaction. *Information & Management,* 29**,** 305-315.
WANG, Y.-S. & SHIH, Y.-W. 2009. Why do people use information kiosks? A validation of the Unified Theory of Acceptance and Use of Technology. *Government Information Quarterly,* 26**,** 158-165.
WANG, Y. S., WU, M. C. & WANG, H. Y. 2009. Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology,* 40**,** 92-118.
YANG, H., LEE, H. & ZO, H. 2017. User acceptance of smart home services: an extension of the theory of planned behavior. *Industrial Management & Data Systems,* 117**,** 68-89.
YOO, S. J., HAN, S.-H. & HUANG, W. 2012. The roles of intrinsic motivators and extrinsic motivators in promoting e-learning in the workplace: A case from South Korea. *Computers in Human Behavior,* 28**,** 942-950.
YUEH, H.-P., LU, M.-H. & LIN, W. 2016. Employees' acceptance of mobile technology in a workplace: An empirical study using SEM and fsQCA. *Journal of Business Research,* 69**,** 2318-2324.
ZEITHAML, V. A. 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing,* 52**,** 2-22.
ZHOU, T., LU, Y. & WANG, B. 2010. Integrating TTF and UTAUT to explain mobile banking user adoption. *Computers in human behavior,* 26**,** 760-767.