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Individual Differences in the Adoption and Secure Use of Smart Home Technology

Dr Emma Williams, School of Management, University of Bristol
Dr Emma Slade, School of Management, University of Bristol
Dr Duncan Hodges, Information and Operations Group, Cranfield University
Dr Phillip Morgan, School of Psychology, Cardiff University

Abstract

This developmental paper focuses on work that is currently being conducted to investigate individual differences in the adoption and secure use of smart home-based technologies by consumers. Specifically, the research focuses on individual differences in two primary psychological characteristics (risk taking propensity and impulsivity), technology adoption propensity, and a range of socio-demographic factors (including age, gender, and education level), to explore their potential influence on the adoption and secure use of smart home technologies at the consumer level. Through an online survey in December 2019-January 2020, 633 responses were collected from UK-based participants. These data will be discussed at the conference in order to understand the potential for further development and analysis of the data collected in relation to various theoretical perspectives, thus maximizing the potential theoretical contribution of the research across the management discipline.

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1. Introduction

Smart devices can be defined as "everyday items that connect to the Internet" (NCSC, 2019). In relation to smart homes, such devices are considered to be items in the home that can be controlled remotely by the homeowner (often via a mobile app) and include items such as smart TVs, smart locks, voice assistants (such as Amazon's Alexa), smart lights, and smart 'wireless' surveillance/CCTV systems.

Due to the intrinsic capability of smart technologies to communicate with other networked devices, many smart home appliances are considered part of what is known as the 'Internet of Things' (IoT). Within the academic literature, previous definitions of what constitutes a smart home have focused on both technical aspects (e.g., the presence of various networked sensors) and more user-focused aspects, such as the ability to use automated technology to respond to the needs of home-owners, with a focus on integration and collaboration within the home environment (e.g., Balta-Ozkhan, Davidson, Bicket & Whitmarsh, 2013; De Silva, Morikawa & Petra, 2012; Marikyan, Papagiannidis & Alamanos, 2019).

Smart home technologies provide many benefits to consumers in terms of time and convenience. They also have the potential to assist in addressing a range of current societal issues, including sustainable energy use and tailored healthcare. However, the increased connectivity that accompanies such technologies also presents substantial risks related to cyber security, data privacy and even physical safety (Blythe & Johnson, 2020; Heartfield, Loukas, Budimir, Bezemskij, Fontaine, Filippoupolitis & Roesch, 2018; Marikyan et al, 2019). Despite these security risks, in their analysis of the content of marketing materials related to smart home technologies from 62 organisations, Wilson, Hargreaves and Hauxwell-Baldwin (2017) found data security to only be mentioned in eight of these materials.

The behaviour of consumers with regards to checking default settings on their smart devices, setting up and managing their devices securely, and ensuring that the device's software is kept up-to-date can all help to reduce the security risks of smart home technology (NCSC, 2019). Therefore, to maximise the potential benefits that such technologies provide and minimize the potential risks associated with their use, it is crucial to understand both what influences different groups of consumers to use such technologies and how they choose to interact with them. This developmental paper details research that aims to address this.

2. Literature Review

A number of factors have been identified that influence consumers' intentions to adopt technology in general, including how useful the technology is considered to be and how easy it is to use (e.g., the Technology Acceptance Model; Agarwal & Prasad, 2007; Chau, 1996; Davis, 1989; Kim & Shin, 2015; Lin, Shih, & Sher, 2007); attitudes, social norms, and perceived personal skill and control in effectively managing the technology (e.g., the Theory of Planned Behaviour; Ajzen, 1991; de Boer, van Deursen & van Rompay, 2019; Mani & Chouk, 2018; Park, Kim & Jeong, 2018; Wilson et al, 2017; Wünderlich, Wangenheim & Bitner, 2013; Yang, Lee & Zo, 2017); and perceived risk, trust, and security (e.g., Featherman & Pavlou, 2003; Gefen, Karahanna & Straub, 2003; Luo, Li, Zhang & Shim, 2010; McKnight, Choudhury & Kacmar, 2002). Overall, users have been found to vary according to their perceptions of security and privacy risks related to technology and the extent to

which these risks are considered to be an issue (Marikyan et al, 2019). Early adopters of technology are also considered to have higher prior awareness regarding new technologies, perceive stronger benefits in using the technology, and consider the potential risks of these technologies to be easier to manage (Rogers, 2003).

Recent work has focused explicitly on consumer adoption of smart home technologies, with perceived security risks found to influence intentions to use smart home devices and trust in those devices, albeit showing small effects (Klobas, McGill & Wang, 2019; Shuhaiber & Mashal, 2019). When considering adoption of in-home voice assistants, individuals who did not intend to purchase such a device have been found to have significantly greater concerns regarding how the data generated by these devices might be used and also lower confidence in the security of that data (Liao, Vitak. Kumar, Zimmer & Kritikos, 2019). Higher privacy concerns and previous experience of a privacy violation have also been associated with lower levels of support for smart meters in a survey of 1035 US consumers (Hmielowski, Boyd, Harvey & Joo, 2019). In their survey of 409 German participants, Hubert, Blut, Brock, Zhang, Koch and Riedl (2019) identified risk perception, perceived usefulness and compatibility as influencers of intention to adopt smart home technologies. Of particular interest, they considered a range of different risk facets, including security risk, performance risk and time risk. All of these risk facets were found to influence overall risk perceptions, with security risk showing the strongest effect. Security risk was also found to have the greatest indirect effect on behavioural intentions. Similarly, Hong, Nam and Kim (2020) explored the role of performance risk, financial risk, privacy risk, and psychological risk, finding that all but financial risk increased consumer resistance to smart home services.

Considering smart home applications as risky has also been associated with decreased likelihood of using such applications and considering them to be less useful (Kleijnen, De Ruyter & Wetzels, 2007; Lee, 2009). Interestingly, the role of risk perceptions related to different types of smart home devices (e.g., those that serve obvious security versus entertainment needs) has not yet been considered, with Hubert et al (2019) suggesting that, theoretically, such smart home device types may influence some of the relationships shown above. In their survey study, Shin, Park and Lee (2018) asked respondents about their adoption of large (e.g., fridges, washing machines), small (e.g., plugs, lighting), and safety and security-related smart home appliances (e.g., locks, CCTV). Overall, safety and security-related products were often found to be purchased earlier than other smart homes devices.

In their diary and interview study relating to the use of smart speakers, Lau, Zimmerman and Schaub (2018) found that users often trade privacy for convenience and that current privacy controls are rarely used due to poor alignment with users' current needs. Overall, convenience and the desire to be an early adopter were highlighted as drivers by current users of smart speakers, whereas non-users cited security and privacy concerns, and a lack of usefulness of the technology. The authors found no evidence of specific privacy-seeking behaviours by users related to their device. Conversely, Mamonov and Benbunan-Fich (2019) found that information privacy and security concerns did not influence the intention to adopt smart locks, with the relative advantages of smart locks compared to traditional locks in *providing* security being the primary consideration.

Interestingly, socio-demographic factors such as income have also not been consistently found to influence intentions, suggesting that price concerns do not have a substantial role on intentions to adopt smart home technologies (e.g., Hmielowski, Boyd, Harvey & Joo, 2019; Hubert et al, 2019; Juric & Lindenmeier, 2019; Parag & Butbul. 2018). However, in their survey of 653 German consumers, Juric & Lindenmeier (2019) did find effects for other socio-demographic characteristics, with younger consumers and male consumers being more likely to adopt smart lighting products than older consumers and female consumers. Conversely, Shin et al (2018) found that younger consumers had lower intentions to purchase a range of smart home devices. Klobas et al (2019) also investigated the role of age and education level in adoption of smart home devices and found that older consumers (those over 40 years of age) and those who held a degree were more likely to consider potential security risks in their decision making. Similarly, McLean and Osei-Frimpong (2019) surveyed 766 UK consumers and found that privacy concerns have a greater influence on adoption of in-home voice assistants in households with a greater number of occupants compared to smaller households, although they did not explore the potential role of composition dynamics in this (i.e., adults only versus adults and children).

2.1. Individual Differences in Smart Home Technology Adoption and Use

To date, research relating to IoT devices from the user perspective has predominantly focused on the needs of an ageing population, since smart home devices provide a key opportunity to help older adults maintain their independence (Coughlin, D'Ambrosio, Reimer & Pratt, 2007). This has resulted in a call for more consumer-focused research across broader user groups (Marikyan et al, 2019). Such an approach would also enable a greater understanding of the role of various individual difference characteristics on adoption and use behaviours.

The Technology Adoption Propensity (TAP) index (Ratchford & Barnhart, 2012) attempts to combine many of the concepts identified by previous literature within a single theoretical framework. It focuses on identifying consumers' positive and negative attitudes towards new technology in general, rather than focusing on any specific type. Two primary factors are highlighted that are considered to *inhibit* the adoption of new technology (perceived *vulnerability* and concern about *dependence* on the technology) and two that *contribute* to adoption (perceived *proficiency* and *optimism* with regards to interacting with the technology). Such concepts are also likely to relate to individual differences in risk taking propensity more generally. Indeed, early adopters of technologies are considered to be more willing to take greater risks in order to trial innovations than more risk-averse, slower to adopt consumers (Rogers, 2003), and risk taking has also been linked with cybercrime victimization (Holt & Bossler, 2014).

The psychological construct of impulsivity, measured by the Barratt Impulsiveness Scale (Patton, Stanford & Barratt, 1995), has also been explored in relation to secure use of technology, with Jeske, Briggs and Coventry (2016) finding in their study of 104 people that impulsivity was associated with more frequent use of risky public wireless networks when using mobile devices. This suggests that a greater understanding of the role of such psychological characteristics in the adoption and secure use of smart home technology would be beneficial.

3. The Current Study

This study aims to investigate the influence of a number of individual difference characteristics on the adoption and secure use of smart home technology, considering how the behaviour of these different user communities may contribute to security vulnerabilities. In particular, a quantitative survey methodology is used to examine the following key questions:

1. To what extent do individual differences in risk taking propensity and impulsivity influence self-reported (a) adoption and (b) secure use behaviours related to smart home technology?

2. To what extent do individual differences in socio-demographic characteristics, specifically age, gender, education level, and employment status, influence self-reported (a) adoption and (b) secure use behaviours related to smart home technology?

3. To what extent do individual differences in generic technology adoption propensity influence self-reported (a) adoption and (b) secure use behaviours related to smart home technology?

Through an online survey in December 2019-January 2020, 633 responses were collected from UK-based participants. These data will be discussed at the conference in order to understand the potential for further development and analysis of the data collected in relation to various theoretical perspectives, thus maximizing the potential theoretical contribution of the research across the management discipline.

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Williams, Emma

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