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Emma Slade

Swansea University, emmaslade@hotmail.co.uk

Michael Williams

Swansea University, m.d.williams@swansea.ac.uk

Yogesh Dwivedi

Swansea University, ykdwivedit@gmail.com

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EXTENDING UTAUT2 TO EXPLORE CONSUMER ADOPTION OF MOBILE PAYMENTS

Emma L Slade

School of Business, Swansea University, Swansea, SA2 8PP, UK

Email: emmaljade@hotmail.co.uk

Michael D Williams

School of Business, Swansea University, Swansea, SA2 8PP, UK

Email: M.D.WILLIAMS@swansea.ac.uk

Yogesh K Dwivedi

School of Business, Swansea University, Swansea, SA2 8PP, UK

Email: ykdwivedi@gmail.com

Abstract

There is a growing interest in studying the adoption of m-payments but literature on the subject is still in its infancy and no empirical research relating to this has been conducted in the context of the UK to date. The aim of this study is to unveil the current situation in m-payment adoption research and provide future research direction through the development of a research model for the examination of factors affecting m-payment adoption in the UK context. Following an extensive search of the literature, this study finds that 186 relationships between independent and dependent variables have been analysed by 32 existing empirical m-payment and m-banking adoption studies. From analysis of these relationships the most significant factors found to influence adoption are uncovered and an extension of UTAUT2 with the addition of perceived risk and trust is proposed to increase the applicability of UTAUT2 to the m-payment context.

Keywords: Mobile payments, Adoption, UTAUT2, Perceived risk, Trust

Introduction

Mobile payments (m-payments) arose as a crucial aspect of mobile data services (MDS) development and can be considered a radical e-payment innovation as a seamless part of MDS acquisition and mobile commerce (m-commerce), as well as a MDS in their own right (Barnes, 2002; Goeke & Pousttchi, 2010; Kreyer et al., 2002; Kristoffersen et al., 2008; Pousttchi, 2008). The widespread adoption of m-commerce by both consumers and merchants is largely dependent on a secure and reliable payment system so that it is convenient and easy to use (Chang et al., 2009; Kreyer et al., 2002); therefore m-payment is one of the most critical drivers of the success of m-commerce (Yang et al., 2012). In addition to stakeholders such as financial service providers, payment service providers, consumers and merchants, whom are shared

with other payment systems, m-payments involve stakeholders such as mobile network operators (MNOs), mobile device manufacturers, and content developers and providers (Au & Kauffman, 2008; Lu et al., 2011).

None of the existing payment systems are ubiquitously accepted leaving consumers forced to carry multiple methods (Chen, 2008). The advantages of m-payment systems are that they are not restricted to certain transaction situations, they have the benefit of mobility, and are not restricted to the availability of ATMs (Dahlberg & Mallat, 2002; Gerpott & Kornmeier, 2009; Mallat, 2007); therefore, they may offer the first ubiquitous payment solution, thus delivering a distinctive value to both consumers and merchants (Lai & Chuah, 2010). M-payments have featured heavily in the UK media since 2012 as a result of the introduction of new systems such as Barclays' Pingit and Orange's Quick Tap (e.g. Cave, 2012; Cellan-Jones, 2012; Garside, 2012; Locke, 2012; Warman, 2012a & 2012b) and m-payments are now a specifically denoted project of the UK Payments Council (The Payments Council, 2012).

Despite the advantages that alternative payment systems might offer, consumers' payment choice tends to be limited to cash, cheque, debit or credit card, and there is a general reluctance to adopt new payment systems as a result of consumers' entrenched behaviour (Hayashi & Klee, 2003; Humphrey et al., 1996; Weichert, 2008). Moreover, the complexity of the m-payment environment, with various offerings from a number of different uncoordinated providers using different technologies has left consumers confused (Dredge, 2012). With the exception of a handful of countries, the application of various m-payment solutions have not been as successful in Europe and North America in comparison with Asian countries and developing countries and many have experienced low adoption rates or failure to date (Cellan-Jones, 2012; Dahlberg & Öörni, 2007; Ondrus & Pigneur, 2007; Schierz et al., 2010).

The pace and nature of payment systems innovation is affected by the vested interest that financial institutions and businesses have in existing systems and the need to achieve alignment between a number of stakeholders to reach a critical mass of adopters (Gaur & Ondrus, 2012; Weichert, 2008). Therefore, there is a problematic

situation whereby investment must be made in order to attract consumers to adopt m-payment systems, but the certainty that consumers will adopt new systems must be high in order for financial institutions and businesses to make such investments (Chen, 2008). Despite the importance for stakeholders of understanding consumer adoption, no single framework has yet emerged. Thus, reviewing current m-payment adoption research is important to map what has already been done. This study unveils the existing m-payment adoption literature and both the adoption theories and constructs that have been used in the m-payment context. Although Dahlberg et al.'s (2008) review of the literature briefly analysed the constructs used in m-payment adoption research, a systematic review of all constructs used in m-payment adoption research in order to develop a theoretically grounded model has not yet been conducted. Once published, the development of a comprehensive adoption model will benefit both researchers and practitioners wanting to evaluate consumer adoption of m-payment systems.

The remainder of this paper will be as follows. Firstly, we will briefly identify and examine the dominant theories that have been applied in m-payment and m-banking adoption research. From these theories we will then select an appropriate theory for further application and extension. We will then analyse the relationships between independent and dependent variables that have been examined in this context to date to select the most significant factors appropriate for inclusion as extensions to the selected theory. Finally, the paper will be concluded, its contributions highlighted and limitations and potential avenues for future research discussed.

Literature review

From the initial search of m-payment adoption research via *Google School*® and *ISI Web of Knowledge*®, 29 articles relating to m-payment adoption were found; however, a significant number of these were qualitative or exploratory studies (Dahlberg et al., 2003; Dewan & Chen, 2005; Lai & Chuah, 2010; Mallat, 2007; Mallat & Tuunainen, 2008; Mbogo, 2010; Teo et al., 2005; Viehland & Leong, 2007) or had failed to empirically validate the proposed models (Amoroso & Magnier-Watanabe, 2012; Chen & Adams, 2005; Lee et al., 2004; Tan et al., 2011; Zhang et al., 2011; Zmijewska et al, 2004), thus leaving 15 empirical articles appropriate for

inclusion. Although m-payments and m-banking are two distinct branches of mobile financial services some of their characteristics overlap, for example the transfer of money directly from account to account and sourcing funds for m-payments, all conducted via a mobile device (Dass & Pal, 2011; Lin, 2011). The inclusion of empirically validated m-banking adoption research on this basis increased the collection of appropriate articles to 32 (Table 1.).

The earliest academic m-payment adoption research dates to 2003 (Dahlberg et al., 2003); however, as one would expect with emerging themes, research was initially exploratory and thus mostly qualitative or descriptive in nature (e.g. Dahlberg et al., 2003; Lee et al., 2004; Mallat, 2007; Teo et al., 2005). Although quantitative research examining m-payment adoption began to emerge in 2004 (Cheong et al., 2004), it was not until 2009 that significantly more research began to be published (Gerpott & Kornmeier, 2009; Goeke & Pousttchi, 2010; Hongxia et al., 2011; Huang & Liu, 2012; Kim et al., 2010; Lu et al., 2011; Mallat et al., 2009; Peng et al., 2012; Schierz et al., 2010; Shin, 2010; Wang & Yi, 2012; Yang et al., 2012); therefore m-payment adoption research is still in its infancy. Moreover, whilst the 32 relevant academic articles sourced have taken place across 11 different countries, no research has been conducted in the UK context.

Theory	Source	Application	Location	Comment(s)
DOI	Brown et al., 2003	m-banking	South Africa	Explained 38 per cent of variance in behavioural intention
	Suoranta, 2003	m-banking	Finland	Explained variance figures excluded, only demonstrates model fit
D-TPB	Püschel et al., 2010	m-banking	Brazil	Explained 68.6 per cent of variance in behavioural intention
TAM	Akturan & Tezcan, 2012	m-banking	Turkey	Explained 52.9 per cent of variance in behavioural intention
	Chen, 2008	m-payment	US	Explained variance figures excluded, only demonstrates model fit
	Cheong et al., 2004	m-payment	Korea	Explained 55.1 per cent of variance in behavioural intention
	Goeke & Pousttchi, 2010	m-payment	Germany	Explained 75.7 per cent of variance in behavioural intention
	Gu et al., 2009	m-banking	Korea	Explained 72.7 per cent of variance in behavioural intention

	Kim et al., 2010	m-payment	Korea	Explained variance figures excluded, only demonstrates model fit
	Koenig-Lewis et al., 2010	m-banking	Germany	Explained 65.1 per cent of variance in behavioural intention
	Luarn & Lin, 2005	m-banking	Taiwan	Explained 82 per cent of variance in behavioural intention
	Mallat et al., 2009	Mobile ticketing	Finland	Explained 55 per cent of variance in behavioural intention
	Peng et al., 2012	Tourism m-payment	China	Explained variance figures excluded, only demonstrates model fit
	Riquelme & Rios, 2010	m-banking	Singapore	Explained 50 per cent of variance in behavioural intention
	Schierz et al., 2010	m-payment	Germany	Explained 84 per cent of variance in behavioural intention
	Shin, 2010	m-payment	US	Explained 72 per cent of variance in behavioural intention and 81 per cent of variance in use behaviour
	Sripalawat et al., 2011	m-banking	Thailand	Explained 68.5 per cent of variance in behavioural intention
UTAUT	Hongxia et al., 2011	m-payment	China	Explained variance figures excluded, only demonstrates model fit; excluded UTAUT moderators
	Wang & Yi, 2012	m-payment	China	Explained variance figures excluded, only demonstrates model fit; excluded UTAUT moderators
	Yu, 2012	m-banking	Taiwan	Explained 60.4 per cent of variance in behavioural intention and 65.1 per cent of variance in actual behaviour; included two UTAUT moderators
	Zhou et al., 2010	m-banking	China	Explained variances of user adoption of the individual UTAUT and TTF models were 45.7 per cent and 43.3 per cent respectively, whereas the integrated model explained 57.5 per cent of variance in user adoption; excluded UTAUT moderators
Valence framework	Lu et al., 2011	m-payment	China	Explained 44.2 per cent of variance in behavioural intention
	Yang et al., 2012	m-payment	China	Explained variances of intention were 49.5 per cent for potential users and 54.5 per cent for current users
IS Success Model	Zhou, 2011	m-banking	China	Explained 52.5 per cent of variance in behavioural intention

Lacks dominant theory	Dahlberg & Öörni, 2007	m-payment and electronic invoices	Finland	Explained 25.1 per cent of variance in behavioural intention to use m-payments, and 19.5 per cent of variance in behavioural intention to use electronic invoices
	Gerpott & Kornmeier, 2009	m-payment	Germany	Explained 68 per cent of variance in behavioural intention
	Huang & Liu, 2012	m-payment	China	Explained variance figures excluded, only demonstrates model fit
	Kim et al., 2009	m-banking	Korea	Explained 31 per cent of variance in behavioural intention
	Lin, 2011	m-banking	Taiwan	Explained variance figures excluded, only demonstrates model fit
	Luo et al., 2010	m-banking	US	Explained 55.9 per cent of variance in behavioural intention
	Shen et al., 2010	m-banking	Taiwan	Explained variance figures excluded, only demonstrates model fit
	Zhou, 2012	m-banking	China	Explained 38.7 per cent of variance in behavioural intention and 47.8 per cent of variance in actual usage

Table 1. Empirically validated adoption research in the m-payment and m-banking context

Dominant theories used in m-payment and m-banking adoption research

Analysis of the 32 existing empirical studies relating to m-payment and m-banking adoption revealed that the most commonly used core theories included the Diffusion of Innovation theory (DOI), the Decomposed Theory of Planned Behaviour (D-TPB), the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), the Valence Framework, and the IS Success Model (Table 1.). Although eight of the studies failed to use a core theory to underpin their research, all of them did utilise several relationships from established IS theory.

Roger's (1995) DOI proposes that the rate of technology adoption will increase when consumers perceive the innovation to have greater relative advantage, observability, trialability and compatibility, together with less complexity. Whilst several qualitative studies have adopted DOI (Mallat, 2007; Mallat & Tuunainen, 2008) and DOI constructs have been added as extensions to empirical m-payment adoption research (e.g. Chen, 2008; Dahlberg & Öörni, 2007; Lu et al., 2011), our review of the

quantitative literature found only two studies that used DOI as the core theory, both of which examined m-banking adoption (Brown et al., 2003; Suoranta, 2003). In comparison to other studies which applied different research models, DOI was relatively unsuccessful, explaining only 38 per cent of variance in behavioural intention in Brown et al.'s (2003) study.

The Theory of Planned Behaviour (TPB), derived from the field of social psychology, suggests that behaviour is a direct function of behavioural intention, which is itself driven by an individual's attitude, subjective norms and perceived behavioural control (Ajzen, 1991). D-TPB extends TPB by decomposing the antecedents of attitudinal beliefs. Despite explaining 68.6 per cent of variance in behavioural intention to adopt m-banking in Püschel et al.'s (2010) study, this is the only study to have used D-TPB as the core model; however, its components such as subjective norm have been included by other research (e.g. Schierz et al., 2010; Sripalawat et al., 2011).

TAM translated models from the field of social psychology to IS. According to TAM, usage is a direct function of behavioural intention, which itself is influenced by attitudes towards the IS formulated from the innovation's perceived usefulness and perceived ease of use (Davis, 1989). Although originally intended as a model to predict employee acceptance of technology and usage in the organizational context, more recently TAM has also been applied to examine individual acceptance of technology in a consumer context (Schepers & Wetzels, 2007). In addition to the studies that have not empirically validated the proposed extensions of TAM (e.g. Amoroso & Magnier-Watanabe, 2012; Tan et al., 2011; Zhang et al., 2011; Zmijewska et al., 2004) 14 of the 32 empirically validated m-payment and m-banking adoption studies have used TAM as the core theory, making it the most used of all the theories that have been implicated in this area. With its various extensions it has explained more than 50 per cent (Riquelme & Rios, 2010), and up to 84 per cent (Schierz et al., 2010), of variance in behavioural intention across all studies where explained variance figures were included.

Based on criticism of the predictive capacity of TAM, Venkatesh et al. (2003) developed UTAUT to explain employee technology acceptance and use. From a thorough review of eight prominent user adoption models, including DOI, TPB, and

TAM aforementioned, several key constructs were derived: performance expectancy which is similar to perceived usefulness in TAM and relative advantage in DOI; effort expectancy which is similar to TAM's perceived ease of use and DOI's complexity; social influence which is similar to subjective norm in TPB and DOI's image; and facilitating conditions which is similar to compatibility in DOI and perceived behavioural control in TPB (Venkatesh et al., 2003). The effect of these constructs on behavioural intention or use behaviour was posited to be moderated by different combinations of gender, age, experience and voluntariness of use. However, three of the four studies that have empirically validated UTAUT in the m-payment or m-banking context have excluded UTAUT moderators (Hongxia et al., 2011; Wang & Yi, 2012; Zhou et al., 2010), which has commonly been the case amongst adoption studies that employ UTAUT (Venkatesh et al., 2012). Moreover Yu (2012) only examined the effect of two of UTAUT's four moderators, age and gender, and only examined the effect of each of these singularly rather than comparing their moderating effects alone and in tandem. The deficiency in examination of interaction terms is surprising given that Venkatesh et al. (2003) found the inclusion of them to be salient in improving the model's predictive ability. Zhou et al. (2010) found UTAUT to explain 45.7 per cent of variance in user adoption, but when integrated with Task-technology Fit theory (TTF) predictability increased to 57.5 per cent, thus demonstrating the potential to increase the success of UTAUT through extension with additional constructs.

As a 'cognitive-rationale' consumer decision-making theory, the valence framework theorizes that consumer decision-making is fundamentally affected by positive and negative valences, or aspects of behavioural beliefs: negative valences being undesirable features and positive being desirable (Peter & Tarpey, 1975). The two existing studies that have used the valence framework were applying it in the m-payment context (Lu et al., 2011; Yang et al., 2012). Both studies integrated other constructs, most notably from DOI. The model was found to explain up to 54.5 per cent of variance in behavioural intention (Yang et al., 2012).

DeLone & McLean's (1992) Information Systems Success Model proposed that system quality and information quality affect use and user satisfaction, both of which are antecedents of individual impact, which in turn affects organizational impact.

Following the application of the IS Success Model by other researchers, DeLone & McLean (2003) later updated the model to add a third dimension, system quality, and also combined individual impact and organizational impact into a single variable, 'net benefits'. Although Zhou's (2011) study achieved good predictive ability using the IS Success Model, 14 other studies examining m-banking and m-payment adoption with the models described above achieved better predictive ability.

Theoretical model selection

TAM, with its various extensions, has been the most widely used model for examination of m-payment and m-banking adoption. However, whilst TAM has been proven as a reliable and valid model of user technology adoption, it has been criticised for supplying very general information on individuals' opinions of novel technologies, of having a deterministic approach without much consideration for users' individual characteristics, and for assuming that usage is volitional without constraints (Agarwal & Prasad, 1999; Mathieson et al., 2001; McMaster & Wastell, 2005).

In a similar vein to other IS adoption models such as TAM, UTAUT was originally developed to explain employee technology acceptance within an organizational context. Therefore, based on a further review of the extant literature, Venkatesh et al. (2012) proposed the extension of UTAUT, to what they termed UTAUT2, in order to tailor it to the consumer technology acceptance context. UTAUT2 incorporates a further three key constructs, positing that hedonic motivation, price value and habit also affect behavioural intention, the effects of which are moderated by different combinations of three of the original four moderators, gender, age and experience (Table 2.); as UTAUT2 is intended for the consumer context, Venkatesh et al. (2012) removed the fourth moderating variable, voluntariness of use, assuming that consumer behaviours are voluntary. The model further adapts the original UTAUT through the addition of a direct relationship between facilitating conditions and behavioural intention, which is drawn from the relationship of perceived behavioural control with intention and behaviour in TPB. Similarly, habit is also hypothesised to directly affect both behavioural intention and use behaviour. In addition to these changes, Venkatesh et al. (2012) also found that the effect of behavioural intention on use is moderated by experience. Used to examine mobile internet, a technology used by m-payments,

Venkatesh et al.'s (2012) extension of UTAUT, compared with the original model, produced a substantial improvement in the explained variance of behavioural intention, from 56 per cent to 74 per cent, and also a significant improvement in the explained variance of usage, from 40 per cent to 52 per cent.

Independent variable	Dependent variable	Moderators	Explanation
Facilitating conditions	Behavioural intention	Age and gender	Effect stronger for older women
Facilitating conditions	Technology use	Age and experience	Effect stronger for older individuals with high levels of experience with the technology
Performance expectancy	Behavioural intention	Age and gender	Effect stronger for younger men
Effort expectancy	Behavioural intention	Age, gender, and experience	Effect stronger for older women with limited experience of the technology
Social influence	Behavioural intention	Age, gender, and experience	Effect stronger for older women with limited experience of the technology
Habit	Behavioural intention	Age, gender and experience	Effect stronger for older men with high levels of experience with the technology
Habit	Technology use	Age, gender and experience	Effect stronger for older men with high levels of experience with the technology
Hedonic motivation	Behavioural intention	Age, gender, and experience	Effect stronger for younger men with limited experience of the technology
Price value	Behavioural intention	Age and gender	Effect stronger for older women
Behavioural intention	Technology use	Experience	Effect stronger for individuals with limited experience of the technology

Table 2. Summary of validated UTAUT2 hypotheses

Whilst some models within the IS context have reached a relative level of maturity the same cannot be said of UTAUT2 for which replication and generalizability studies, as well as those examining the model's predictive validity, are still much more limited in number. Venkatesh et al. (2012) suggested that future research should apply UTAUT2 in different countries, across different age groups, and on different technologies. It was also recommended that future research should attempt to identify other relevant factors to extend UTAUT2 thus providing support for this study. For these reasons, the selection of UTAUT2 as the core model for extension by this study is justified. Although the model will not be empirically tested by this study, the extensions suggested are in the context of m-payments which, despite using mobile internet, is a different technology.

Model extension

Construct analysis of the existing m-payment and m-banking adoption research revealed that 186 relationships between independent and dependent variables had been examined, of which 12 relationships were found to be significant by four or more studies (Table 3.). The independent variables of these relationships included attitude, behavioural intention, compatibility, perceived ease of use, perceived financial cost, perceived risk, perceived usefulness, performance expectancy, relative advantage, social influence, and trust. As all but two of these constructs are already either captured by UTAUT2 constructs or have been proven to be insignificant (Venkatesh et al., 2012; Venkatesh et al., 2003), then further analysis of these relationships is excluded from this paper, thus leaving perceived risk and trust as possible extensions of UTAUT2 in the m-payment context.

Independent variable	Dependent variable	Significant	Not significant
Perceived ease of use	Perceived usefulness	Akturan & Tezcan, 2012; Cheong et al., 2004; Goeke & Pousttchi, 2010; Gu et al., 2009; Kim et al., 2010 (early & late adopters); Koenig-Lewis et al., 2010; Luarn & Lin, 2005; Peng et al., 2012; Riquelme & Rios, 2010; Schierz et al., 2010; Sripalawat et al., 2011	
Perceived usefulness	Behavioural intention	Chen, 2008; Cheong et al., 2004; Goeke & Pousttchi, 2010; Gu et al., 2009; Kim et al., 2010 (early & late adopters); Koenig-Lewis et al., 2010 ; Luarn & Lin, 2005; Peng et al., 2012; Riquelme & Rios, 2010; Sripalawat et al., 2011; Zhou, 2011	Akturan & Tezcan, 2012; Mallat et al., 2009
Perceived ease of use	Behavioural intention	Chen, 2008; Dahlberg & Öörni, 2007; Goeke & Pousttchi, 2010; Gu et al., 2009; Kim et al., 2010 (early & late adopters); Luarn & Lin, 2005; Mallat et al., 2009; Peng et al., 2012; Sripalawat et al., 2011	Koenig-Lewis et al., 2010
Perceived risk	Behavioural intention	Brown et al., 2003; Chen, 2008; Koenig-Lewis et al., 2010; Lu et al., 2011; Luo et al., 2010; Riquelme & Rios, 2010; Shin, 2010; Sripalawat et al., 2011; Yang et al., 2012 (potential & current adopters)	Hongxia et al., 2011; Huang & Liu, 2012; Suoranta, 2003; Wang & Yi, 2012
Compatibility	Behavioural intention	Chen, 2008; Dahlberg & Öörni, 2007; Koenig-Lewis et al., 2010; Lu et al., 2011; Mallat et al., 2009; Schierz et al., 2010; Suoranta, 2003; Yang et al., 2012 (potential & current adopters)	Brown et al., 2003

Attitude	Behavioural intention	Akturan & Tezcan, 2012; Cheong et al., 2004; Gerpott & Kornmeier, 2009; Lin, 2011 (potential users); Püschel et al., 2010; Schierz et al., 2010; Shin, 2010	
Trust	Behavioural intention	Gu et al., 2009; Huang & Liu, 2012; Kim et al., 2009; Lu et al., 2011; Shin, 2010; Zhou, 2012; Zhou, 2011	Goeke & Pousttchi, 2010; Koenig-Lewis et al., 2010
Perceived financial cost	Behavioural intention	Hongxia et al., 2011; Lu et al., 2011; Luarn & Lin, 2005; Sripalawat et al., 2011; Yang et al., 2012 (potential adopters); Yu, 2012	Koenig-Lewis et al., 2010; Yang et al., 2012 (current adopters)
Social influence	Behavioural intention	Hongxia et al., 2011; Püschel et al., 2010; Riquelme & Rios, 2010; Sripalawat et al., 2011; Yang et al., 2012 (potential & current adopters); Yu, 2012	Shin, 2010; Wang & Yi, 2012
Behavioural intention	Actual use	Hongxia et al., 2011; Sripalawat et al., 2011; Yu, 2012; Zhou, 2012	
Performance expectancy	Behavioural intention	Hongxia et al., 2011; Luo et al., 2010; Wang & Yi, 2012; Yu, 2012	
Relative advantage	Behavioural intention	Brown et al., 2003; Lu et al., 2011; Yang et al., 2012 (potential & current adopters); Suoranta, 2003	

Table 3. Most tested relationships in the context of m-payments and m-banking

Hypotheses development

Venkatesh et al. (2012) suggested that future work examined other key constructs salient to different research contexts. A number of constructs used within the context of m-banking and m-payment can be corresponded with UTAUT2's constructs. However, whilst trust and perceived risk are critical factors in consumer adoption of payment systems they are not represented in UTAUT2 and hence are selected as constructs to incorporate into the model.

Perceived risk and trust have been investigated by a significant number of studies in the m-banking and m-payment context. Constructs that have been employed to explore perceived risk include privacy concerns (Chen, 2008; Huang & Liu, 2012) and security concerns (Chen, 2008). Moreover, Akturan & Tezcan (2012) differentiated perceived risk into a number of risk dimensions, including perceived social, performance, financial, time, security, and privacy risks, but of these found only perceived social and performance risks to be significant. The effect of perceived risk, as a singular construct, on behavioural intention has been proven to be significant

by numerous studies (Brown et al., 2003; Chen, 2008; Koenig-Lewis et al., 2010; Lu et al., 2011; Luo et al., 2010; Riquelme & Rios, 2010; Shin, 2010; Sripalawat et al., 2011; Yang et al., 2012) (Table 3.). Trust has been traditionally difficult to define and has been treated as both a unitary and multidimensional concept (McKnight et al., 2002). Dimensions of trust have been explored in the m-banking and m-payment context with constructs such as calculative-based trust (Gu et al., 2009), perceived credibility (Luarn & Lin, 2005; Yu, 2012), and structural assurances (Gu et al., 2009; Kim et al., 2009; Luo et al., 2010; Zhou, 2012; Zhou, 2011). However, the effect of trust as a unitary construct on behavioural intention has proven to be significant by a greater number of studies (Gu et al., 2009; Huang & Liu, 2012; Kim et al., 2009; Lu et al., 2011; Shin, 2010; Zhou, 2012; Zhou, 2011) (Table 3.). Given that the inclusion of perceived risk and trust as singular, rather than multidimensional, constructs has proven successful by a large number of studies then, for the purpose of parsimony, this study will extend UTAUT2 with one construct to measure perceived risk and one construct to measure trust.

Perceived risk

A consumers' perception of risk is derived from feelings of uncertainty or anxiety about the behaviour and the seriousness of the possible outcomes of the behaviour. The shared characteristics of m-payment and m-banking indicate that they may experience similar potential risk sources, such as vulnerability to security violations resulting from wireless communications infrastructure (Kim et al., 2009; Luo et al., 2010; Shin, 2010). Moreover, the complexity of the m-payment environment, with various offerings from a number of different uncoordinated providers using different technologies has left consumers confused, which will in turn increase the perceived risk in the technology (Dredge, 2012; Gaur & Ondrus, 2012). Given the infancy of m-payment systems and the uncertainty of the environment then it is likely that adoption of m-payments will be negatively affected by perceptions of risk. Indeed, perceived risk has been found to be the second most significant predictor of behavioural intention by Luo et al. (2010) and Riquelme & Rios (2010).

According to DOI technology adoption varies according to people's differences in innovativeness and higher levels of uncertainty will have a lesser effect on more innovative individuals' acceptance of a technology (Rogers, 1995). According to

research by Ofcom (2011) there is a significant difference in take-up of communications technologies between younger and older age groups in the UK. This suggests that younger people are more innovative and less affected by perceptions of risk in the context of adoption of mobile technology. Moreover, due to their earlier adoption of smartphone technology it is likely that younger people are more experienced with mobile payments as a part of m-commerce and so perceived risk will affect their behavioural intention less. Although gender differences in technology usage have long been documented, there is little evidence of the effect of perceived risk on behavioural intention when moderated by gender. From their findings, Slyke et al. (2002) suggested reducing risk perception would improve women's perceptions of Internet shopping. This suggests that women are more affected by perceived risk when adopting a technology than men. Therefore, based on the existing findings and limited evidence of the effect of interaction terms in the context of m-payments, we hypothesise that in addition to the UTAUT2 relationships:

H1: Age, gender and experience moderate the negative effect of perceived risk on behavioural intention to adopt m-payments, such that the effect will be stronger for older females with limited experience of the technology.

Trust

Trust is a subjective belief that a party will fulfil their obligations and it plays an important role in uncertain financial transactions where users of the system are vulnerable to financial loss (Gefen et al., 2003; Lu et al., 2011). In addition, trust is even more important in electronic transactions, which are characterised by anonymity and lack of social cues due to spatial separation (Zhou, 2012). As m-payments are facilitated by a variety of uncoordinated providers we propose the examination of trust in the system.

Trust can help to reduce high perceptions of risk as trust helps users to overcome uncertainty or anxiety of the behaviour and its possible outcomes (McKnight et al., 2002). Gefen et al. (2003) suggested that research should examine the relationship between trust and perceived risk. Several m-payment and m-banking adoption studies found trust to have a negative effect on perceived risk (Huang & Liu, 2012; Koenig-

Lewis et al., 2010; Lu et al., 2011). Based on these findings we hypothesise that in addition to the UTAUT2 relationships:

H2a: Trust negatively affects perceived risk of m-payments.

A total of seven studies have found trust to have a significant positive effect on behavioural intention to adopt m-banking or m-payments (Gu et al., 2009; Huang & Liu, 2012; Kim et al., 2009; Lu et al., 2011; Shin, 2010; Zhou, 2012; Zhou, 2011). Slyke et al. (2002) found that perceptions of trust in Internet shopping significantly differed by gender. Gefen et al. (2008) suggested that differences in the effect of trust on behaviour across genders should be considered more seriously. Whilst Awad & Ragowsky (2008) found that the effect of trust on behavioural intention was important for both genders, it was slightly more important for women. Although consumers may have limited experience of using more novel proximity m-payment systems, they may have been using remote m-payment systems for more than a decade, usually unwittingly, to pay for ringtones and logos for their devices. As experience can facilitate trust then it is likely that experience will moderate the effect of trust on behavioural intention so that trust is more salient for those with less experience. Yu (2012) did not examine the moderating effect of experience on the grounds that the research was not longitudinal and therefore could not capture increasing levels of user experience at different times, but experience can also be captured by the time since first usage (Venkatesh et al., 2012). As well as the moderating effects of gender and experience, age is likely to be an important interaction term. As younger people in the UK have been less hesitant in their adoption of smartphones (Ofcom, 2011) it is likely that trust will have a lesser effect on their intention to adopt m-payments. Therefore, based on the existing findings and limited evidence of the effect of interaction terms in the context of m-payments, we hypothesise that in addition to the UTAUT2 relationships:

H2b: Age, gender, and experience moderate the effect of trust on behavioural intention to adopt m-payments, such that the effect will be stronger for older females with limited experience of the technology.

Summary and conclusion

A review of the m-payment adoption literature revealed that only 15 empirical studies had been conducted to examine m-payment adoption; therefore, as a closely related mobile financial service, m-banking adoption research was also included in the review. Theories that have currently been implicated in m-payment and m-banking adoption research include DOI, D-TPB, TAM, UTAUT, the valence framework, and the IS Success Model, although TAM has been used significantly more than any other. As UTAUT has been applied in the m-payment adoption research it was deemed that UTAUT2 would be an appropriate model to select for future m-payment adoption research. Following construct analysis of the current m-payment and m-banking adoption research perceived risk and trust were chosen as appropriate extensions of UTAUT2 in the m-payment context and the relationships were hypothesised.

Contribution

This study has made two significant contributions. Firstly, it has consolidated existing m-payment adoption knowledge through a systematic review of the relevant research to examine the theories and constructs already used in order to propose a theoretically grounded model of consumer m-payment adoption. Secondly, it has fulfilled Venkatesh et al.'s (2012) suggestion to identify other relevant factors to extend UTAUT2, thus providing future research direction through the development of a research model for the examination of factors affecting m-payment adoption.

Limitations and future research

This study has only examined existing empirical adoption research relating to m-payments and m-banking. However, m-payments are also closely associated with m-commerce. Therefore, future research could strengthen the construct analysis through investigation of existing m-commerce adoption research. Future application of the proposed model by empirical research to examine adoption of m-payments in the UK context would provide a contribution to theoretical knowledge based on the recommendations of Venkatesh et al. (2012), and also fill this current void in m-payment adoption research to aid stakeholders' understanding of UK consumer m-payment adoption. As none of the studies that have utilised UTAUT in the m-payment

or m-banking context have examined the effect of all of the interaction terms then empirical validation of this model would also validate the effects of these moderating variables.

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